NWC-TN-

TECHNICAL NOTE 404-216

A-7 ALOFT DEMONSTRATION
Flight Test Plan

by

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China Lake, California

FOREWORD

This report describes the Flight Test Program to be accomplished by the Naval Weapons Center as part of the Airborne Light Optical Fiber Technology (ALOFT) Demonstration.

This report is released at the working level for information purposes only.

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CONTENTS

AIRBORNE LIGHT OPTICAL FIBER TECHNOLOGY DEMONSTRATION PROGRAM PLAN

1.0 INTRODUCTION

1.1 PURPOSE. The purpose of this plan is to provide a comprehensive description of the Airborne Light Optical Fiber Technology (ALOFT) Demonstration Flight Test Program to be conducted by the Naval Weapons Center (NWC), China Lake, California. The objective of the test program is to demonstrate the feasibility of utilizing a fiber-optical transmission system as a means of interfacing aircraft avionics systems, using an A-7C aircraft as the test bed. The NWC flight test plan provides general and specific information pertaining to the manner in which NWC will accomplish its assigned tasks. This plan is promulgated in response to and forms a part of the Naval Electronics Laboratory Center (NELC) ALOFT Demonstration Test Plan.

1.1.1. TEST PLAN APPROACH. Improper operation of any of the avionics systems in the aircraft will result in a corresponding degradation in navigation/weapons delivery system accuracy. Therefore, all avionics systems will be monitored closely, as will navigation/weapons delivery system accuracy, and all failures will be investigated thoroughly to determine their causes.

2.0 TASK ASSIGNMENTS

2.1 NWC was tasked by NELC, with the approval of Naval Air Systems Command, to conduct the flight test portion of the A-7 ALOFT Demonstration program. The Naval Electronics Laboratory Center, San Diego, California,

is directing the ALOFT Demonstration program. Other participants are Federal Systems Division, IBM Corporation, Owego, New York, Vought Systems Division, LTV Aerospace Corporation, Dallas, Texas, and Naval Air Test Center (NATC), Patuxent River, Maryland.

2.1.1 TASK DESCRIPTION. NWC was assigned fourteen (14) specific tasks which were to be performed during the period 1 February 1975 through 1 October 1976, consisting of selected laboratory tests, aircraft installations, aircraft ground tests, aircraft flight tests, and the reporting and documentation of the tests and installations performed.

2.1.1.1 TASK NO. 1. This task directed NWC to identify the changes required in the Operational Flight Program (OFP) and Operational Test Program(OTP) to utilize an ALOFT TC-2 Computer in the test bed aircraft. The task was completed on 15 February 1975.

2.1.1.2 TASK NOS. 2A and 2B. Task 2A directed NWC to perform an OFP/OTP compatability test in conjunction with IBM and to submit a report of results and recommendations. Task 2B directed NWC to prepare and deliver an ALOFT OFP/OTP. By agreement with NELC and NAVAIR, these tasks, which were originally scheduled to be completed 15 February 1975 and 1 April 1975, respectively, were rescheduled for completion at IBM on or about 4 August 1975 and have been completed.

2.1.1.3 TASK NOS. 3A, 3B, and 3C. Task 3A directed NWC to provide minimal support to NELC in development of an ALOFT Laboratory Test Plan; Task 3B directed NWC to provide major support to NELC in development of an ALOFT Acceptance Test Plan; and Task 3C directed NWC to provide major support to NELC in development of an ALOFT Simulator Test Plan. The Laboratory Test Plan was developed by IBM and published as IBM Document 74-M56-018, dated

10 April 1975, which NWC has reviewed and found to be acceptable. NWC advised NELC by telephone that the plan was acceptable and that no further NWC effort on tasks 3A and 3C was required or contemplated. Task 3B, which was originally scheduled for completion on 15 May 1975, was completed at IBM on or about 4 August 1975 in conjunction with Tasks 2A and 2B.

2.1.1.4 TASK NOS. 3D, 4, and 7. Task 3D directed that NWC prepare "preflight" (i.e. pre-demonstration) validation and coordinated demonstration flight plans and submit such plans to NELC not later than 1 October 1975. The assignment instructions gave NWC the option of combining the pre-demonstration validation and the demonstration flight program plans into one document, if desired. This program plan excercises that option and NWC has further elected to incorporate program plans for all other assigned tasks into this document, as well. Task 4 assigns the entire responsibility for conducting a pre-demonstration (pre-flight) validation test to NWC and established a completion date goal of 15 January 1976. Task 7 assigns NWC the entire responsibility for conducting all demonstration flights but provides for ALOFT systems engineering support from IBM/NELC. The demonstration flight program will consist of a minimum of fifty (50) flight hours (including baseline flights) and is scheduled for completion on 1 July 1976.

2.1.1.5 TASK NO. 5. This task assignment authorizes NWC to conduct baseline flights if deemed necessary and established a completion date goal of 15 November 1975. However, the scope of this effort and the projected availability date for the ALOFT computer necessitate extending the completion date for this task to 16 March 1976.

2.1.1.6 TASK NOS. 6 and 8. These tasks direct NWC to install the ALOFT modification in the test bed aircraft prior to performing the flight test, to remove the ALOFT modification after the demonstration flight program has been completed, to restore the aircraft to its delivery configuration, and to reverify that the aircraft is operating as it did upon receipt, prior to release of the aircraft.

2.1.1.7 TASK NOS. 9 and 10. These tasks require NWC to submit a flight test report and a final test report, both of which will be prepared jointly by NWC and NELC personnel, and that monthly progress reports be submitted to NELC. Task 9 requires that NWC collect and reduce flight test data, that NWC and NELC personnel analyze this data, and that the results and conclusions derived from the analysis be compiled into a flight test report, which will also describe the conduct of the flight test phase, including any comments and recommendations pertaining to future flight testing of fiber optics systems. Some of the data, such as Flight Accuracy Summaries, that will be used to compile the flight test report will be classified. If NELC elects to include the Flight Accuracy Summaries as an integral part of the ALOFT Project final report, it is recommended that they be published as a classified supplement to the final report. A completion date goal of 1 September 1976 has been established. Task 10 requires NWC to provide minimal support to NELC in writing the ALOFT Project final report and establishes a completion date goal of 1 November 1976. The level of effort at NWC will be determined at a later date by mutual agreement between NWC and NELC.

2.1.1.7.1 NWC will submit a monthly report to NELC describing the progress made during the previous month. This report will be in the form of revisions to the applicable appendices of this plan.

2.1.1.8 DOCUMENTATION. Documentation of the tests performed by NWC maintenance personnel will be limited to the use of standard 3M data maintenance forms. Systems failures involving ALOFT hardware will be documented just as any other maintenance failure is recorded. When NWC maintenance personnel have definitely isolated the cause of a failure to an ALOFT system component, NWC will advise the NELC/IBM liaison personnel of the failure. Corrective maintenance on ALOFT components and the documentation thereof will be accomplished by NELC/IBM liaison personnel. Documentation of all maintenance action on ALOFT components as well as ALOFT associated avionics equipment will be forwarded to NATC for Reliability and Maintainability Analysis.

2.1.1.8.1 In addition to the 3M maintenance data forms, the following types of data will be available for use in compiling the required reports:

a. Pilot's Flight (knee) Cards

b. A-7 Aircraft Flight Records

c. Pilot's Debrief Records

d. Flight Recorder Data

e. Range Correlation Data

f. Flight Accuracy Summaries (classified)

g. Aircraft Historical Records

h. Special Graphs, etc., (upon request)

3.0 METHOD OF ACCOMPLISHMENT.

3.1 The program will be conducted in three phases: Phase I is the pre-demonstration validation phase; Phase II is the baseline flight phase;

and Phase III is the demonstration flight phase. During the pre-demonstration validation phase, the aircraft will be checked in three configurations. The three configurations of the aircraft are as follows:

a. Fleet Aircraft

b. ALOFT/COPPER

c. ALOFT/FIBER OPTIC

3.1.1 The "fleet" configuration refers to the aircraft system as it is delivered to NWC, with a standard computer and utilizing the current fleet Operational Flight Program (OFP).

3.1.2 The "ALOFT/COPPER" configuration refers to the aircraft system when the standard computer has been replaced by a computer that is capable of being used with either copper wire or fiber optic interfaces. In this configuration, a modified OFP and copper wire interfaces are utilized.

3.1.3 The "ALOFT/FIBER OPTIC" configuration refers to the aircraft system when the computer used in the "ALOFT/COPPER" configuration has been further modified to be usable with optical fiber interfaces only. In this configuration, various aircraft wire interfaces will be replaced by optical fiber interfaces and a modified OFP will be utilized.

3.1.4. PRE-DEMONSTRATION VALIDATION PLAN. The pre-demonstration validation plan is based upon an analysis of the test objectives as defined in the NELC ALOFT Master Test Plan, the Acceptance Test Plan, and the Simulator Test Plan. Pre-demonstration validation includes a cursory validation (which is essentially a 40-hour safety-of-flight check) of the Operational Flight Program (OFP), using either the simulator or the aircraft, selected ground tests, performance of an Operational Test Program (OTP) in accordance with applicable publications, and various

grooming (navigation and radar evaluation) flights. The Pre-demonstration validation requirements, the configuration(s) to which they apply, and where each task is performed are contained in Table 1. A detailed description of the pre-demonstration validation program is contained in Appendix A.

TASK TITLE	Fleet		ALOFT/COPPER		ALOFT/FIBER OPTIC	
	LAB	ACFT	LAB	ACFT	LAB	ACFT
BORESIGHT		X				
OTP FLEET		X				
OTP ALOFT			X	X		X
CURSORY VALIDATION			X			
SYSTEM TEST		X	X			X
PROJECT TEST (see note 1)		X		X		X
GROOMING FLIGHTS (NAVIGATION AND RADAR EVALUATION)		X		X		X

NOTES:

1. The Project Test will consist of tape recorder data reduction only unless otherwise specified.

Table 1. Pre-demonstration Validation Requirements

3.1.5 BASELINE FLIGHT TEST PLAN. NWC will conduct ten (10) baseline flights in the "fleet" configuration and then ten (10) in the ALOFT/COPPER configuration, funds permitting. The flights in each configuration will be the same. The first ten (10) demonstration flights will be identical to the baseline flights to provide a basis for comparison of the ALOFT/FIBER OPTIC configuration to the "fleet" and ALOFT/COPPER configurations. A detailed description of the baseline flight program is contained in Appendix B.

3.1.6 ALOFT SYSTEM INSTALLATION. This task requires NWC to install the ALOFT system components in the test bed aircraft prior to baseline and demonstration flights in accordance with applicable modification directions. The task description requires LTV to provide NWC with the necessary installation drawings and stipulates that even though NWC is responsible for installation of all ALOFT equipment, NELC and IBM personnel will be on site and available to advise and assist in those portions of the checkout and installation that involve the ALOFT hardware. The task further specifies that NELC will provide ALOFT installation hardware in the form of a kit and that NWC's hardware responsibilities will be limited to providing small hardware items, which are normally available in an airframe shop pre-expended bin, and electrical connectors, if required. NATC will evaluate accessibility for visual and manipulative tasks, interchangeability, weight, safety, environment, and labeling of assemblies and components where possible. A detailed description of the ALOFT modification installation plan is contained in Appendix C.

3.1.7 ALOFT SYSTEM REMOVAL AND AIRCRAFT REVERIFICATION. This task assigns NWC the responsibility for removal of all ALOFT hardware, instrumentation, etc., after completion of the flight test program, for reinstallation of any components removed prior to flight test, and for post-flight test reverification of the test bed aircraft. On-site NELC personnel will assume custody of all ALOFT-peculiar hardware after removal. Certification of reverification will be accomplished by use of standard aircraft maintenance forms, aircraft records, and pertinent 3M data entries, as applicable. A detailed description of

the ALOFT modification removal and aircraft reverification plan is also contained in Appendix C.

3.1.8 DEMONSTRATION FLIGHT PLAN. The first ten (10) demonstration flights will be identical to the baseline flights. Additional flights will be conducted as the NELC Program Manager may direct. Scheduling, coordination, and control of range instrumentation time, flight time and flight-test support are the responsibility of NWC but major variations from the approved demonstration flight plan will be submitted to NELC Code 1640 for approval prior to implementation. NWC is responsible for maintenance, support and routine documents of all test bed aircraft systems except ALOFT-peculiar hardware. Logistical and maintenance support of ALOFT-peculiar hardware will be provided by IBM. When the failure of any system is diagnosed to be caused by malfunction of ALOFT-peculiar hardware, NWC will notify the NELC ALOFT Project Systems Engineer who will oversee assignment and performance of corrective maintenance by IBM support personnel. The 3M documentation of ALOFT failures will be performed by IBM with NWC/NATC assistance as required to ensure accurate use of the 3M codes. A detailed description of the Demonstration Flight Plan is contained in Appendix D.

4.0 RELIABILITY AND MAINTAINABILITY

4.1 NATC is tasked to conduct the reliability and maintainability (R & M) evaluation of the ALOFT system. The R & M evaluation will be conducted concurrent with the flight test program. A detailed description of the R & M evaluation plan is contained in Appendix E.

5.0 WEAPONS REQUIREMENTS

5.1 The weapons requirements for the ALOFT program are listed in Figure 2.

WEAPON TYPE	QUANTITY REQUIRED			
	GROOMING	BASELINE	DEMONSTRATION	TOTAL
Mk 76	144	84	42	240
Mk 82 (LDGP)	N/A	12	6	18
Mk 83 (Conical)	N/A	12	6	18
Mk 84 (Conical)			6	6
Mk 106	N/A	12	6	18
20mm AP Ammunition	N/A	N/A	4000	4000
2.75" FFAR Rockets	N/A	N/A	38	38

Figure 2. ALOFT Demonstration Weapons Requirements

6.0 SCHEDULE

6.1 The test plan schedule is shown in Figure 3, which is a milestone chart. The chart presents the proposed schedule of events at NWC for the remainder of the program. Note that the majority of the schedule is dependent upon timely receipt of the ALOFT computer. Delays in receipt of this component will affect the remainder of the schedule on a day-for-day basis.

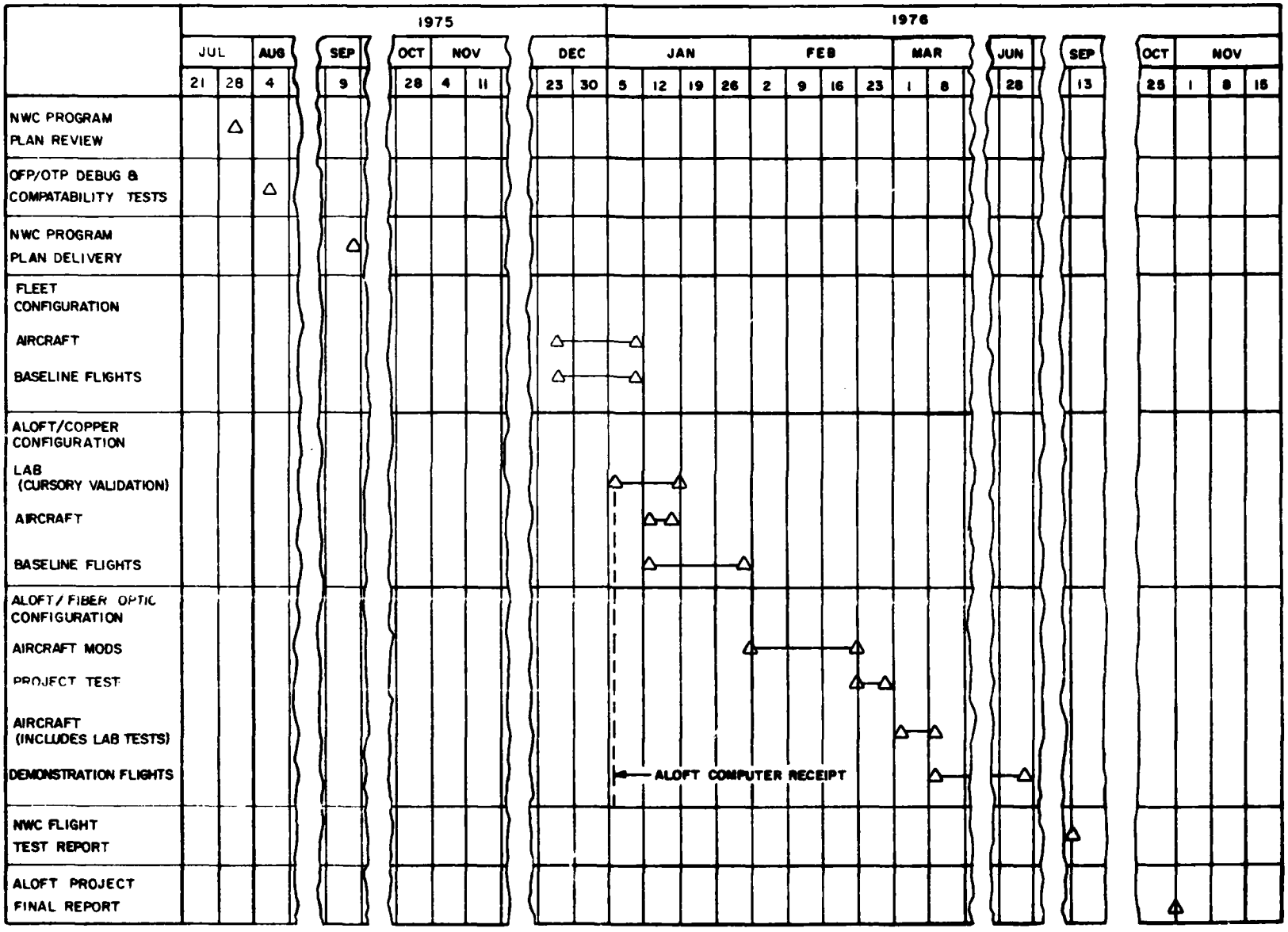


FIGURE 3. NWC ALOFT TEST PLAN SCHEDULE

APPENDIX "A"

PRE-DEMONSTRATION VALIDATION PLAN

SECTION I - INTRODUCTION

1.0 PURPOSE.

1.1 The pre-demonstration validation is the primary method of determining aircraft system integrity prior to performing the ALOFT demonstration flights, and includes checks to demonstrate that the aircraft can properly and safely fly a series of baseline and demonstration flights. The ALOFT pre-demonstration validation consists of a cursory validation, selected aircraft ground checks, and a series of grooming flights to verify systems integrity. This plan consists of an introduction (Section I) and seven additional sections (Sections II through VIII), each of which contains the detailed requirements pertaining to one or more aspects of the pre-demonstration validation program. Section titles are listed in Figure A-1.

SECTION	TITLE
I	INTRODUCTION
II	BORESIGHTING (1)
III	OPERATIONAL TEST PLAN (1), (2)
IV	CURSORY VALIDATION PLAN (2)
V	SYSTEM OPERATIONAL TEST (1), (2)
VI	DRIFT RUN AND AUTO-CAL (1), (2)
VII	PROJECT TEST PLAN (1), (2), (3)
VIII	GROOMING FLIGHT PLAN (1), (2)
NOTES:	(1) For initial aircraft evaluation. (2) For ALOFT/COPPER and ALOFT/FIBER OPTIC configurations. (3) Includes special fiber optic systems tests in addition to instrumentation and flight preparation checklists.

Figure A-1. Section Titles

1.2 The Cursory Validation Plan (Section VI) is partially addressed in paragraph 2.2.6 of the ALOFT Master Test Plan as safety-of-flight test requirements. The ALOFT system demonstration involves the use of two new computer configurations and also utilizes new software. Due to the safety-of-flight implications, the new computers shall be extensively evaluated before demonstration flights begin. The pre-demonstration validation effort will culminate with aircraft grooming flights that will also be used to check the performance of the aircraft systems. To ensure that all systems operate safely and properly in an operational environment, safety-of-flight tests will continue until the system performs satisfactorily to NWC standards.

1.3 The system test (Section V) is an operational test which will be conducted in accordance with applicable technical publications to verify systems integration.

2.0 SCOPE.

2.1 The ALOFT Pre-demonstration Validation Plan is a comprehensive hardware and software evaluation program designed to verify that the two ALOFT computer configurations and associated software are ready for flight, and consists of the following tasks:

a. Evaluation of aircraft in standard (fleet) configuration in preparation for baseline flights. This task will establish performance of the system as it operates "normally" (to NWC standards) and includes grooming flights as required.

b. Evaluation of the ALOFT/COPPER and ALOFT FIBER OPTIC computers and validation of a modified Operational Flight Program and Operational Test Program (OFP/OTP) in preparation for baseline flights. This task will insure proper systems operation and includes grooming flights as required.

3.0 METHOD OF ACCOMPLISHMENT.

3.1 Portions of the pre-demonstration validation will be performed in the NWC integration laboratory and the remainder will be conducted on the aircraft. The specific tasks pertaining to the pre-demonstration validation, the configurations to which they are applicable, and the test where each will be performed are listed in Figure A-2.

TASK TITLE	FLEET		ALOFT/COPPER		ALOFT/FIBER OPTIC	
	LAB	ACFT	LAB	ACFT	LAB	ACFT
BORESIGHT		X				
OTP FLEET		X				
OTP ALOFT			X	X	X	X
CURSORY VALIDATION			X		X	
SYSTEM TEST		X	X		X	X
IMS DRIFT CHECK		X	X	X		X
PROJECT TEST		X	X			X
GROOMING FLIGHTS (NAVIGATION AND RADAR EVALUATION)		X		X		X

Figure A-2. Pre-demonstration Validation Requirements

4.0 DOCUMENTATION.

4.1 The specific documentation requirements pertaining to each portion of the validation program are containing in the appropriate sections of this document. Documentation requirements applicable to all aspects of the validation program are described below.

4.1.1 The primary method of documentation of all malfunctions will be through the use of the Maintenance Action Form (MAF), OPNAV Form 4790/40. Instructions on how to prepare this form are contained in OPNAVINST 4790.2A. Both the forms and the instructions will be available at NWC. The Work Unit Code (WUC) manuals will also be available and NWC maintenance personnel will provide the necessary assistance if questions arise when NELC/IBM personnel are documenting ALOFT System component failures. MAF's pertaining to ALOFT systems components will not be processed through normal maintenance channels. NWC personnel will initiate the MAF but NELC/IBM personnel will be responsible for completion and final disposition of all MAF's in this category. Failures not attributable to ALOFT System components will be documented by NWC maintenance personnel.

4.1.2 The Work Unit Code manuals do not contain WUC's for ALOFT peculiar hardware. The WUC numbers assigned to ALOFT hardware for documentation purposes are listed in Figure A-3.

Work Unit Code	Nomenclature	Part No.
72A00	ALOFT System	
72A10	ALOFT Computer Set	
72A1100	ALOFT Computer	L20-210
72A1110	Page Mux/Demux A100-A1	L20-297
72A1120	Page Mux/Demux A100-A2	L20-296
72A1130	Page Mux/Demux A100-A3	L20-295
72A1140	Page D/A A100-A5	L20-302
72A1150	Page E/O Unit Lit A100-A7	L20-294
72A1160	Page converter A100-A9	6870783
72A1170	Page converter A100-A10	6870780
72A1180	Page converter A100-A11	6870781
72A1190	Page converter A100-A12	6870782
72A19	NOC (Not Otherwise Classified)	
72A20	ALOFT FLR Adapter Set	
72A2100	ALOFT FLR Adapter	L20-248
72A2110	Page Mux/Demux and Lit A1	L20-270
72A2120	Power Supply +/- 5VDC	6095979
72A2130	Power Supply 12 VDC	6095681
72A29	NOC	
72A30	ALOFT ASCU Adapter Set	
72A3100	ALOFT ASCU Adapter	L20-249-1
72A3110	Page assy L Bay and ASCU Lit A3	L20-272
72A3120	Page Mux/Demux A1	L20-267
72A3130	Power Supply +/- 5VDC	6095979
72A3140	Power Supply 12 VDC	6095681
72A39	NOC	
72A40	ALOFT Right Area Adapter Set	
72A4100	ALOFT Right Area Adapter	L20-249-2
72A4110	Page Mux/Demux Lit A1	L20-271
72A4120	Power Supply +/- 5VDC	6095979
72A4130	Power Supply 12VDC	6095681
72A49	NOC	
72A50	ALOFT Left Area Adapter Set	
72A5100	ALOFT Left Area Adapter	L20-249-3
72A5110	Page assy L Bay ASCU Lit A3	L20-272
72A5120	Page Assy L Bay Mux/Demux A1	L20-273
72A5130	Power Supply +/- 5VDC	6095979
72A5140	Power Supply 12 VDC	6095681
72A59	NOC	

Figure A-3. ALOFT Work Unit Codes (Sheet 1 of 2)

Work Unit Code	Nomenclature	Part No.
72A60	ALOFT Cockpit Adapter Set	
72A6100	ALOFT Cockpit Adapter	L20-263
72A6110	Page Assy Lit A/D Conv A4	L20-274
72A6120	Page Assy Mux/Demux A1	L20-275
72A6130	Power Supply	6095981
72A6140	Power Suppl	L20-282
72A6150	Power Supply	6095665
72A69	NOC	

Figure A-3. ALOFT Work Unit Codes (Sheet 2 of 2)

SECTION II - BORESIGHTING

1.0 INTRODUCTION.

1.1 Boresighting consists of aligning the optical and mechanical axes of the aircraft, including alignment of the Angle-of-Attack (AOA) vanes, to NWC standards.

2.0 SPECIAL TOOLS AND TEST EQUIPMENT.

2.1 The following special tools and test equipment are required:

216-00275 Short-range- Boresight Tool

215-00112-28 AOA Vane Alignment Set

3.0 DETAILED REQUIREMENTS.

3.1 Boresighting shall be accomplished in accordance with procedures contained in NAVAIR 01-45AAE-2-14.

3.2 DOCUMENTATION.

3.2.1 System data point information shall be recorded for each of the equipments listed below. The forms on which the information shall be recorded are illustrated in Figures A-4 through A-7 as follows:

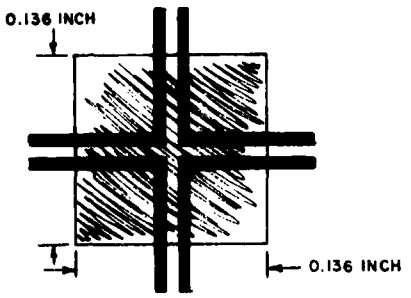
MT-4066/ASN-90(V) IMU Mount (Figure A-4)

MT-4038/AVQ-7(V) Electrical Equipment Mount (Figure A-5)

MT-4034/APQ-126(V) Radar Mount (Figure A-6)

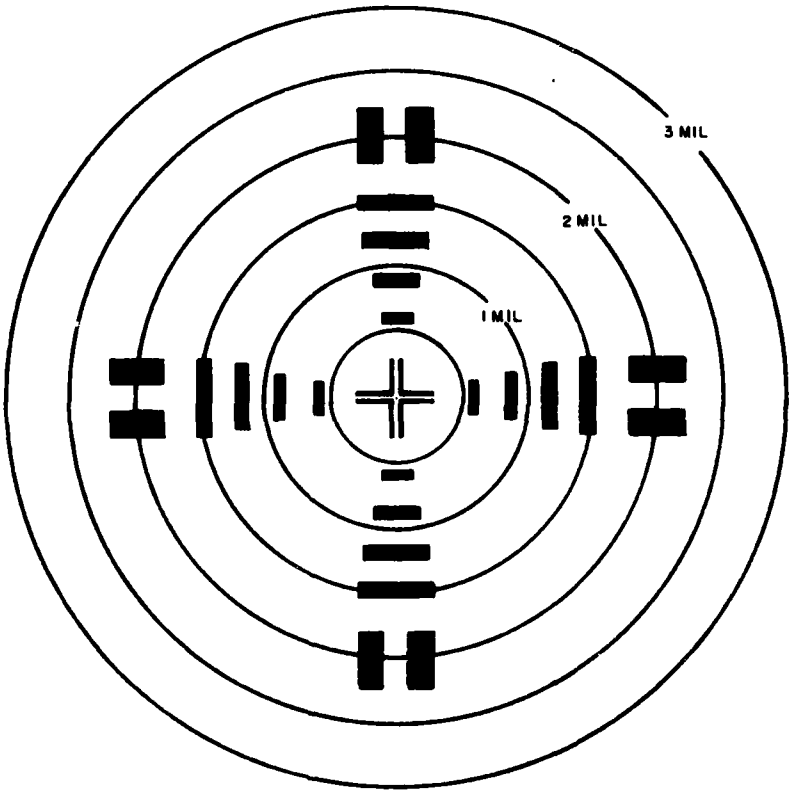
AS-2262/APN-190(V) Antenna Assembly Fixture (Figure A-7)

3.2.2 A MAF shall be prepared to document all failures and malfunctions of aircraft components. Where applicable, MAF numbers shall be cross-referenced to the applicable checklist item number.



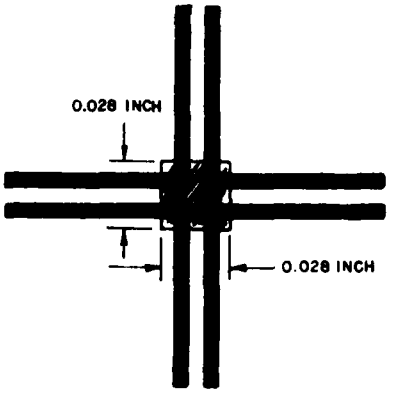
TOLERANCE AREA

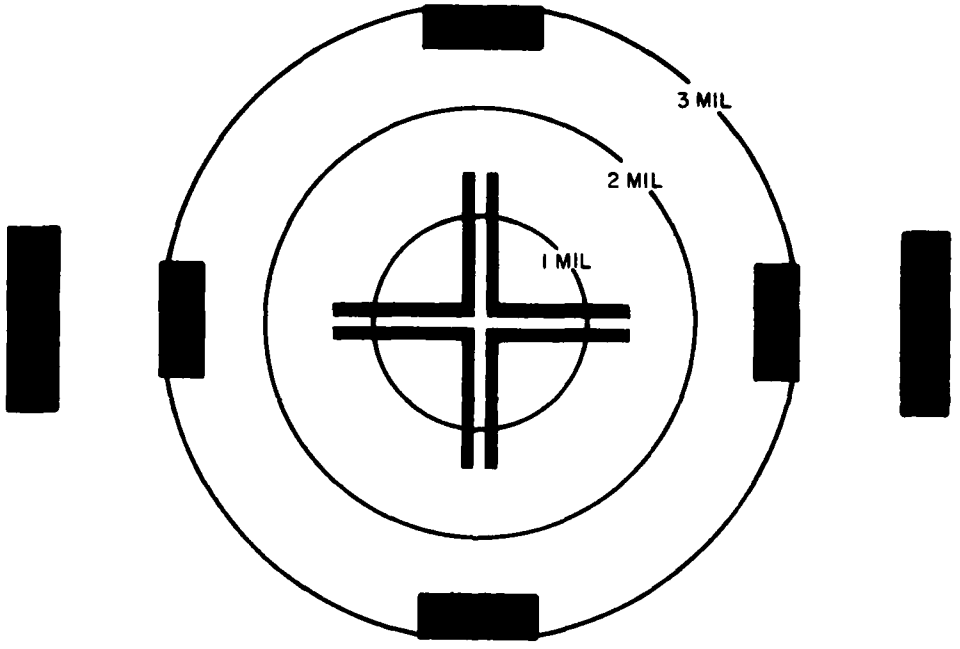
DETAIL A



BORESIGHT ERROR DETERMINATION
MIL CONVERSION CHART

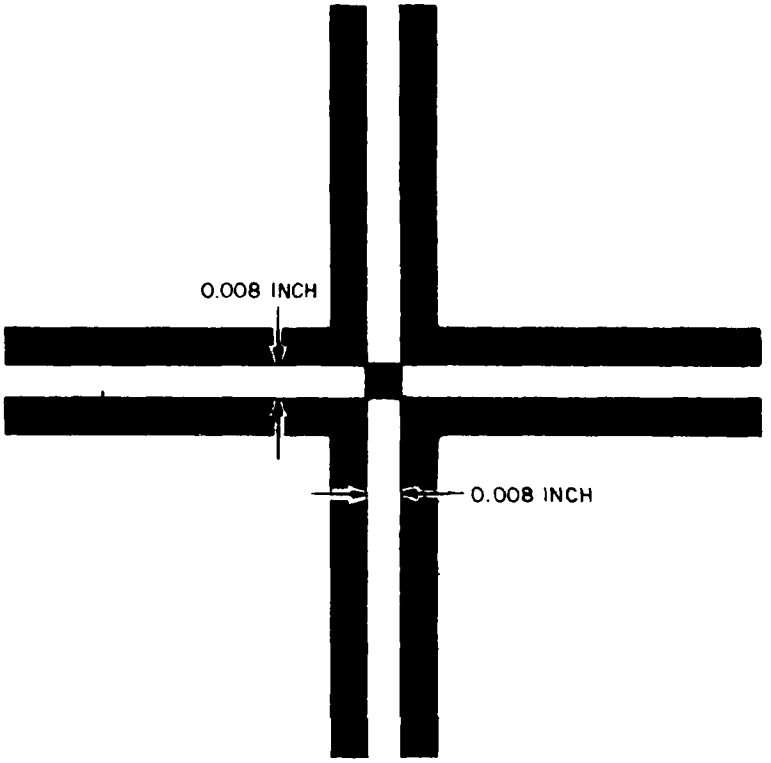
FIGURE A-4 MT-4066/ASN-90(V) IMU MOUNT BORESIGHT TOLERANCE PRESENTATION





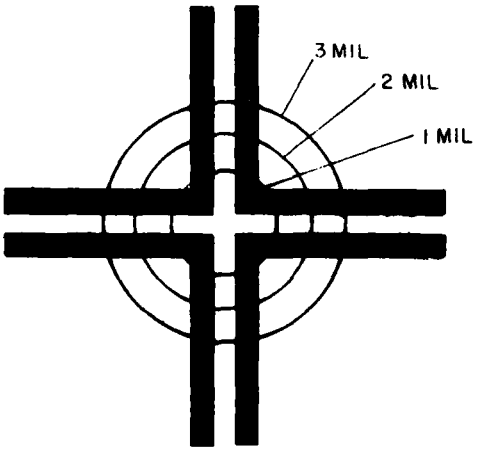
BORESIGHT ERROR DETERMINATION
MIL CONVERSION CHART

FIGURE A-5 MT-4038/AVQ-7 (V) ELECTRICAL EQUIPMENT MOUNT
BORESIGHT TOLERANCE PRESENTATION



TOLERANCE AREA

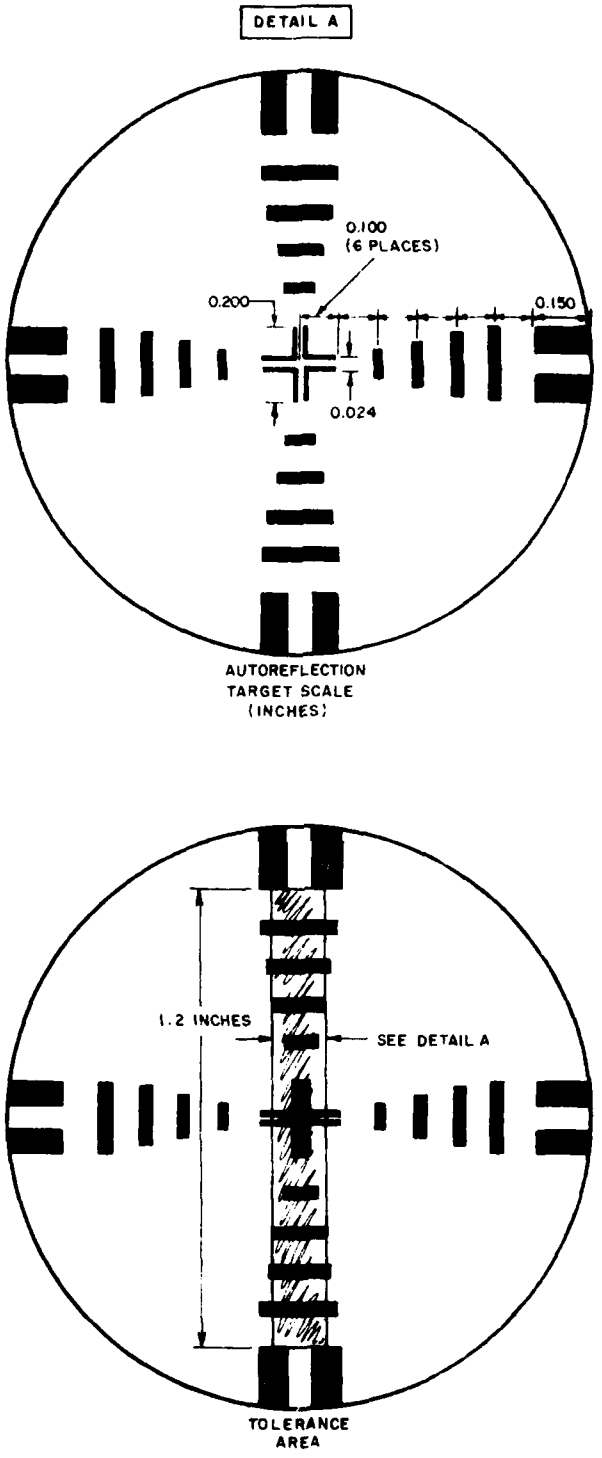
DETAIL A



BORESIGHT ERROR DETERMINATION

MIL CONVERSION CHART

FIGURE A-6 MT-4043/APQ-126 (V) RADAR MOUNT BORESIGHT TOLERANCE PRESENTATION



NOTE

CROSS HAIRS OF TELESCOPE RETICLE MUST OVERLAY AUTOREFLECTION TARGET WITHIN SHADED AREA SHOWN.

FIGURE A-7 AS-2622/APN-190(V) ANTENNA ASSEMBLY FIXTURE BORESIGHT TOLERANCE PRESENTATION

SECTION III - OPERATIONAL TEST PROGRAM

1.0 INTRODUCTION.

1.1 The Operational Test Program (OTP) will consist of ground checks of all systems, including those to be utilized when conducting grooming, baseline, or demonstration flights.

2.0 SPECIAL TOOLS AND TEST EQUIPMENT.

2.1 The following special tools and test equipment are required:

AN/APM-304C APQ-126 Test Set (AGR)

3.0 DETAILED REQUIREMENTS.

3.1 The following tests will not be performed as part of the OTP:

a. Land/Carrier switch test

b. Digital Data Converter test

c. Data Link test

d. SINS test

3.2 The ALOFT modification will not affect the systems listed below, but operation of each will still be monitored. Failures of these systems will be documented as routine failures and do not require notification of NELC/IBM personnel prior to repair.

a. Air Data Computer

b. Radar Altimeter

c. Angle-of-Attack System

d. Weight-on-gear switch

e. Inertial Measurement Set (IMS)/Doppler Interface (Analog)

f. IMS/Attitude Director Indicator (ADI) Interface (Analog)

g. IMS/Forward-Looking Infrared (FLIR) Interface (Analog)

h. Release Tone Generator

3.3 Performance of the Operational Test Program shall be in accordance with the procedures contained in NAVAIR 01-45AAE-2-17.6. All errors and deviations shall be documented as specified below.

3.4 DOCUMENTATION.

3.4.1 A checklist of all items to be accomplished shall be required. The checklist shall contain provisions for noting deviations, failures, and errors, for recording when ALOFT engineering was notified, if applicable, and for cross-referencing the checklist to the appropriate entry on the ALOFT Engineering Report Log. Figure A-8 illustrates a typical checklist.

3.4.2 All ALOFT component failures, malfunctions, and abnormalities of ALOFT-related systems shall be recorded on an ALOFT Engineering Report Log. The log shall provide space for brief descriptions of both the problem and the solution. Each entry shall be assigned a number for identification purposes. Figure A-9 illustrates a typical log entry page. In addition, failures of all systems other than those listed in paragraphs 3.1 and 3.2, above, shall also be recorded on the ALOFT Engineering Report Log.

3.4.3 A MAF shall be prepared to document all failures and malfunctions of aircraft components. Where applicable, MAF numbers shall be cross-referenced to the applicable checklist item number and the ALOFT Engineering Report Log entry number.

OTP CHECKLIST								
NOTE: ALL ILLUSTRATION AND PAGE NUMBERS REFER TO NAVAIR 01-45AAE-2-17.6 UNLESS OTHERWISE SPECIFIED, EACH ITEM ON THE CHECKLIST APPLIES TO BOTH THE FLEET AND THE ALOFT CONFIGURATIONS								
FIGURE No.	PAGE No.	TITLE	RESULTS		REMARKS	ENGR. NOTIFY DATE	REPORT No.	REPORT SUBMIT DATE
			PASS	FAIL				
2-3	2-21	C-7830/ASN-91(V) Tactical Computer Control OTP Testing/ Troubleshooting Diagram						
2-4	2-22	AN/APN-190(V) Radar Navigation Set OTP Testing/Trouble-shooting Diagram						
2-6	2-24	Master Arm Switch OTP Testing/Troubleshooting Diagram (Airplanes After A-7 Airframe Change No. 226)						
2-7	2-25	Armament Release Panel OTP Testing/Trouble-shooting Diagram						
2-8	2-26	CP-953/AJQ or CP-953A/ AJQ Air Data Computer OTP Testing/Trouble-shooting Diagram						
2-9	2-27	ID-1013/A Horizontal Situation Indicator OTP Testing/Trouble-shooting Diagram						

Figure A-8. OTP Checklist (Sheet 1 of 6)

OTP CHECKLIST								
NOTE: ALL ILLUSTRATION AND PAGE NUMBERS REFER TO NAVAIR 01-45AAE-2-17.6 UNLESS OTHERWISE SPECIFIED, EACH ITEM ON THE CHECKLIST APPLIES TO BOTH THE FLEET AND THE ALOFT CONFIGURATIONS								
FIGURE No.	PAGE No.	TITLE	RESULTS		REMARKS	ENGR. NOTIFY DATE	REPORT No.	REPORT SUBMIT DATE
			PASS	FAIL				
2-10	2-28	AN/APN-141(V) Electronic Altimeter Set OTP Testing/Troubleshooting Diagram						
2-11	2-29	AN/APN-194(V) Electronic Altimeter Set OTP Testing/Troubleshooting Diagram (Airplanes After A-7 Airframe Change No. 279)						
2-13	2-32	ID-1329/A Attitude Director Indicator OTP Testing/Troubleshooting Diagram						
2-14	2-34	Advisory Caution Panel OTP Testing/Troubleshooting Diagram						
2-15	2-35	Angle-of-Attack Transducer OTP Testing/ Troubleshooting Diagram						
2-17	2-37	Master Function Switch OTP Testing/Troubleshooting Diagram						

Figure A-8. OTP Checklist (Sheet 2 of 6)

OTP CHECKLIST								
NOTE: ALL ILLUSTRATION AND PAGE NUMBERS REFER TO NAVAIR 01-45AAE-2-17.6 UNLESS OTHERWISE SPECIFIED, EACH ITEM ON THE CHECKLIST APPLIES TO BOTH THE FLEET AND THE ALOFT CONFIGURATIONS								
FIGURE No.	PAGE No.	TITLE	RESULTS		REMARKS	ENGR. NOTIFY DATE	REPORT No.	REPORT SUBMIT DATE
			PASS	FAIL				
2-18	2-45	C-4504/ARW-77 Control Selector OTP Testing/ Troubleshooting Diagram						
2-19	2-46	Target Designate Switch OTP Testing/ Troubleshooting Diagram						
2-20	2-47	Throttle Grip Thumb-wheel Encoder OTP Testing/Troubleshooting Diagram						
2-21	2-48	Weight-on-Gear Switch OTP Testing/Trouble-shooting Diagram						
2-22	2-49	Retarded Weapon Switch OTP Testing/Trouble-shooting Diagram						
2-23	2-50	AN/ASN-90(V) Inertial Measurement Set Mode Function OTP Testing/ Troubleshooting Diagram						
2-24	2-52	IMS-Doppler Interface OTP Testing/Trouble-shooting Diagram						

Figure A-8. OTP Checklist (Sheet 3 of 6)

OTP CHECKLIST								
NOTE: ALL ILLUSTRATION AND PAGE NUMBERS REFER TO NAVAIR 01-45AAE-2-17.6 UNLESS OTHERWISE SPECIFIED, EACH ITEM ON THE CHECKLIST APPLIES TO BOTH THE FLEET AND THE ALOFT CONFIGURATIONS								
FIGURE No.	PAGE No.	TITLE	RESULTS		REMARKS	ENGR. NOTIFY DATE	REPORT No.	REPORT SUBMIT DATE
			PASS	FAIL				
2-25	2-53	IMS-ADI Interface OTP Testing/Troubleshooting Diagram						
2-26	2-54	IMS-FLR Interface OTP Testing/Troubleshooting Diagram.						
2-27	2-55	C-8185/AWE Armament Station Control OTP Testing/Troubleshooting Diagram						
2-28	2-58	Weapon Release Timing OTP Testing/Trouble-shooting Diagram Using AN/AWM-34A						
2-30	2-64	AN/AVQ-7(V) Head-Up Display Set OTP Test-ing/Troubleshooting Diagram						
2-31	2-66	AN/AVQ-7(V) Head-Up Display Set OTP Symbol Control Testing/Trouble-shooting Diagram						
2-32	2-67	AN/APQ-126(V) Radar Set OTP Testing/ Troubleshooting Diagram						

Figure A-8. OTP Checklist (Sheet 4 of 6)

OTP CHECKLIST								
NOTE: ALL ILLUSTRATION AND PAGE NUMBERS REFER TO NAVAIR 01-45AAE-2-17.6 UNLESS OTHERWISE SPECIFIED, EACH ITEM ON THE CHECKLIST APPLIES TO BOTH THE FLEET AND THE ALOFT CONFIGURATIONS								
FIGURE No.	PAGE No.	TITLE	RESULTS		REMARKS	ENGR. NOTIFY DATE	REPORT No.	REPORT SUBMIT DATE
			PASS	FAIL				
2-33	2-70A	AN/ASN-99 Projected Map Display Set OTP Testing/Troubleshooting Diagram						
2-34	2-72	CU-1923/AS Digital Data Converter OTP Testing/Troubleshooting Diagram (Airplanes After A-7 Airframe Change No. 116)						
2-37	2-76	O-1595/A Tone Generator OTP Testing/Trouble-shooting Diagram (Airplanes After A-7 Airframe Change No. 121)						
		FOR ALOFT-CONFIGURED OTP INCLUDE THE FOLLOWING:						
2-32A	2-70	AN/APQ126(V) Radar Set OTP Testing/Trouble-shooting Diagram using AN/APM304C (AGR Test)						
Para. 2-26 thru 2-42	2-77 thru 2-124	Fast Loop OTP and supplementary test						

Figure A-8. OTP Checklist (Sheet 5 of 6)

OTP CHECKLIST								
NOTE: ALL ILLUSTRATION AND PAGE NUMBERS REFER TO NAVAIR 01-45AAE-2-17.6 UNLESS OTHERWISE SPECIFIED, EACH ITEM ON THE CHECKLIST APPLIES TO BOTH THE FLEET AND THE ALOFT CONFIGURATIONS								
FIGURE No.	PAGE No.	TITLE	RESULTS		REMARKS	ENGR. NOTIFY DATE	REPORT No.	REPORT SUBMIT DATE
			PASS	FAIL				
Para. 3-11	3-3	System Performance Test						

Figure A-8. OTP Checklist (Sheet 6 of 6)

ALOFT ENGINEERING REPORT LOG						
REPORT NO.	DATE	PROBLEM	CHK LIST ITEM NO.		DATE	MAF NO.

Figure A-9. ALOFT Engineering Report Log

SECTION IV - CURSORY VALIDATION PLAN

1.0 INTRODUCTION.

1.1 The Cursory Validation Plan is essentially a 40-hour safety-of-flight check. The plan shall be similar in format and content to that contained in NWC Technical Note 140-181.

1.2 The Cursory Validation Plan will be performed in the NWC A-7 Integration Laboratory for the ALOFT/COPPER configuration only.

2.0 SPECIAL TOOLS AND TEST EQUIPMENT.

2.1 No special tools or test equipment are required.

3.0 DETAILED REQUIREMENTS.

3.1 LABORATORY CHECKS.

3.1.1 Navigation Validation. Navigation validation will consist of the following:

a. IMS Alignment

b. IMS Autocalibration ("Autocal")

c. Data Readouts and Entries

d. Reliability/Reasonability Tests

e. Navigation and Alignment Moding

f. Navigation Computations

g. Navigation Updates

3.1.1.1 IMS Alignment. The capability to accurately align the IMS platform shall be tested by performing a series of tests for each alignment method. In addition to the accuracy checks, alignment moding will also be tested.

3.1.1.1.1 IMS Ground Alignments. The capability to accurately ground-align the IMS will be validated by performing alignments at various northern and southern latitudes with varying degrees of platform misalignment. Accuracy of the alignment will then be verified by monitoring data 91 for correct heading. Refer to paragraph 3.1 of TN 404-181 for detailed requirements.

3.1.1.1.2 Airborne Alignment. Airborne alignment capability will be tested by performing a test case matrix of airborne alignments with varying degrees of partial alignments prior to takeoff, entry methods to airborne alignment routine, and at various headings. During the test case runs, the mode will be checked for proper timing, effect of power interrupts, Doppler management, data 23, diagnostic aids, and operation of the IMS NOT ALIGNED light. Accuracy of an airborne alignment will be assessed by forcing a perfect IMS and noting any heading jump at reset. Refer to paragraph 3.4 of TN 404-181 for detailed requirements.

3.1.1.1.3 IMS-HUD Alignment. The IMS-HUD alignment mode will be tested by performing a test matrix in which the amount of platform misalignment and IMS mode selection will be varied. The mode will be functionally checked for correct timing and slewing, effect of power interrupts, diagnostic aids, and control of the IMS NOT ALIGNED light. Refer to paragraph 3.3 of TN 404-181 for detailed requirements.

3.1.1.2 IMS Autocalibration. The capability to control automatic update of the IMS gyro parameters will be tested by performing numerous autocals and observing the accuracy of the computations and functional moding. Paragraph 35 of TN 404-181 contains the details of the autocal

test procedure. Verification will be made that the timing is correct, data is repeatable to within ±0.06°/hour of previous value, heading slew is correct, power interrupts have no effect, and all land-based autocal moding is correct. One-hour drift runs will be performed after each autocal, and drift must not exceed ±5 arc-minutes of heading change or ±2 arc-minutes of present position change.

3.1.1.3 Data Readouts and Entries. In these tests, the capability to respond properly to computer control panel entries, to display correct diagnostic information, and to output correct parameters to the flight recorder channel will be tested. Paragraph 2.1 of TN 404-181, contains the applicable test details. Responses will be observed for correct responses for all data entries except latitudes above 89° 50', which should result errors for both latitude and longitude.

3.1.1.4 Reliability/Reasonability Tests. Control of sensor input information will be tested for the IMS, Doppler, Air Data Computer (ADC), Angle-of-Attack Transducer, Radar Altimeter, Forward-Looking Radar (FLR), and attitude monitor. The software will be verified to correctly apply the reliability and reasonability tests to the input sensor data. The IMS reasonable upper limit of 857 knots will not be checked because the Mission Simulator is unable to attain the necessary velocity. Paragraph 2.4, of TN 404-181 contains the tests to be performed.

3.1.1.5 Navigation and Alignment Moding. The navigation and alignment moding tests are concerned with verifying that the correct navigation mode is selected in response to various system status changes and that the

correct sensor priority and computational method are employed for the selected navigation mode. Essentially, the object of these tests is to verify that the navigation mode reversion is correct. Correct control navigation and alignment moding will be verified. The verification will be performed by utilizing the Control and Display Unit (CADU) capability to stop the OFP when it executes an instruction at a specified memory address. The Tactical Computer memory address for each navigation and alignment moding condition will be obtained from the OFP computer listings and used to stop OFP operation to verify moding.

3.1.1.6 Navigation Computations. The capability to control navigation functions will be verified by performing a matrix of simulated flights for various configurations of alignments, navigation modes, wind inputs, and valid velocity sensors. Accuracy of the computations will be verified by performing updates on targets with known coordinates and by comparing the calculated wind data with the inserted wind data. The system will be observed for accurate performance of navigation computations during all navigation mode configuration tests and for correct steering, information, bearing-to-destination, ground track, and present position. Distance-Measuring Equipment (DME) outputs to the Head-Up Display (HUD), Tactical Computer Control Panel, Horizontal Situation Indicator (HSI), Attitude Director Indicator (ADI), and Projected Map Display System (PMDS) will also be checked for accuracy. Navigation mode reversion in the polar region and below 70° latitude will be verified. Details of the tests are contained in Part 4 of TN 404-181.

3.1.1.7 Navigation Updates. HUD, Radar, PMDS, and Flyover methods of present position update will be verified by testing these functions for computational accuracy and functional moding. The HUD and flyover updates

will be tested in accordance with Part 4 of TN 404-181.

3.1.1.7.1 The HUD update mode will be verified for correct mode entry, range sensor priority, entry of error, and accuracy of computations. HUD update is inhibited by Weight-on-Gear, Attack Mode Selection, or Terrain-Following (TF) mode selection. The HUD update function will be verified to be operational for all destinations, navigation modes, headings, and ranging modes.

3.1.1.7.2 The Flyover update will be functionally checked for correct mode entry, accuracy of computations and moding. Flyover update is inhibited by all attack modes except NAV BOMB and by Weight-on-Gear in all backup modes but is not inhibited by either TF mode or Weight-on-Gear in the prime mode. Flyover update will be verified operational for all destinations, navigation modes, headings, and in NAV BOMB mode.

3.1.1.7.3 PMDS update mode will be verified to have correct mode entry and accurate computations. The mode is inhibited by selection of an attack mode and by Weight-on-Gear in all backup modes.

3.1.2 Weapons Evaluation. Validation of the weapons delivery system will be accomplished by testing the weapons moding and by performing weapons accuracy checks.

3.1.2.1 Weapons Moding Tests. Weapons moding will be checked by verifying that the correct mode selection resulted for various sensor and switch inputs. The moding logic will be checked in accordance with Section 5 of TN 404-180. Comprehensive moding checks will also be performed for each of the following:

3.1.2.1.1 ASCU Codes. Verification will be made that all legal ASCU codes are recognized and invalid codes inhibit attack mode. A check will also be made to verify that the ASCU codes for pilot-option weapons

enable the retarded weapons (RET WPN) switch.

3.1.2.1.2 Manual Ripple. Manual Ripple moding will be verified for mode entry, operation in all navigation modes, including IMS fail and ADC fail, no bomb tone, and weapon release with actuation of release enable. Mode selection is inhibited by Weight-on-Gear and release enable. Bomb spacing is dependent upon horizontal velocity of aircraft.

3.1.2.1.3 Minimum Release Interval. The Minimum Release Interval (MRI) structure will be verified by recording fire pulses on a strip recorder while maintaining a constant g load. The resulting interval between fire pulses will be compared with the MRI equations. Each MRI equation will be verified by selecting a weapon in the desired class and measuring the interval for several values of normal acceleration. By this method, all MRI equations will be verified to be correctly implemented in the prime, backup, and IMS fail modes. Each ASCU code will be tested to determine that the ASCU code/rack type/pilot option resulted in selection of the correct MRI class with one exception: The Mk 87 weapon mounted on the BRU-10 parent rack is cleared for Class II MRI; however, the OFP will place the combination in Class III. Armament Release Panel (ARP) settings for this weapon/rack combination will be limited to a minimum of 100 ft. The automatic reversion to Class II MRI feature will be verified to operate correctly. Changes in ASCU code, quantity, interval, or MRI class are illegal while "STIK" release is in progress.

3.1.2.1.4 Attack Modes. Control of each of the following functions in each attack mode will be verified:

a. Mode selection

b. Target designate

c. FLR moding

d. Weapon release

e. Over the shoulder (OTS) steering

f. Go-around steering

g. Solution cues

h. Ranging hierarchy

i. Destinations

j. Offset data

3.1.2.2 Weapons Accuracy Tests. Weapons accuracy validation will be accomplished by recording on magnetic tape the aircraft flight dynamics during a weapons pass. The magnetic tape will then be used to drive the simulator in the same flight profile; however, the weapons selection, stations, quantity, and interval may be varied as desired on each repeated flight. To be acceptable, the weapon impact scores must be accurate and repeatable.

3.2 HARDWARE INTERFACE CHECKS.

3.2.1 The capability to interface the Tactical Computer with other components of the navigation and weapon delivery system will be tested using actual hardware. The hardware checks will be performed in the laboratory and on the aircraft in accordance with parts 4 and 5 of TN 404-180. Discrepancies noted will be documented on the appropriate forms and logs.

4.0 DOCUMENTATION

4.1 Laboratory documentation requirements will be as specified in the applicable portions of TN404-180 and TN404-181.

SECTION V - SYSTEM CHECKS

1.0 INTRODUCTION.

1.1 System checks to verify systems operation and integration are primarily performed using the Operational Flight Program (OFP). A special OFP tape will be used when the ALOFT Computer is installed in the aircraft.

2.0 SPECIAL TOOLS AND TEST EQUIPMENT.

2.1 The following special tools and test equipment are required:

AN/APM-348 Radar Altimeter Test Set

AN/ASM-478 IMS and Doppler Groundspeed Simulator

3.0 DETAILED REQUIREMENTS.

3.1 Performance during systems checks shall be carefully monitored and thoroughly analyzed to ensure systems integrity. This is extremely important because a new computer will be in use.

NOTE

Systems and switches that are interconnected by fiber optic links may not respond to conventional trouble-shooting techniques. Therefore, whenever an ALOFT component or an ALOFT-related component is suspect, NELC/IBM personnel shall be notified immediately.

3.2 The aircraft systems shall be tested in accordance with NAVAIR 01-45AAE-2-17.2 and problems noted.

3.3 DOCUMENTATION.

3.3.1 Failures and malfunctions of ALOFT-related systems and ALOFT components shall be documented as described in Section III.

3.3.2 A checklist of all items to be accomplished shall be required. The checklist shall contain provisions for noting deviations, failures, and errors, for recording when ALOFT engineering was notified, and for cross-referencing the checklist to the appropriate entry on the ALOFT Engineering Report Log. Figure A-10 illustrates a typical checklist.

3.3.3 A MAF shall be prepared to document all failures and malfunctions of aircraft components. Where applicable, MAF numbers shall be cross-referenced to the applicable checklist item number and the ALOFT Engineering Report Log entry number.

SYSTEMS CHECKS—OPERATIONAL CHECKLIST								
NOTE: ALL TABLE AND PAGE NUMBERS REFER TO NAVAIR 01-45AAE-2-17.2. UNLESS OTHERWISE SPECIFIED, EACH ITEM ON THE CHECKLIST APPLIES TO BOTH THE FLEET AND THE ALOFT CONFIGURATION.								
TABLE No.	PAGE No.	SYSTEM	RESULTS		REMARKS	ENGR. NOTIFY DATE	REPORT No.	REPORT SUBMIT DATE
			PASS	FAIL				
3-1	3-2	ASN-91 NWDC						
3-2	3-7	IMS ALIGNMENT						
3-4	3-14	IMS/HUD/PMDS AND NWDC						
3-7	3-20	SIMULATED AIRBORNE ALIGN						
3-8	3-27	HUD/NWDC INTERFACE						
3-9	3-33	FLR/NWDC INTERFACE						
3-11	3-42	DOPPLER/NWDC INTERFACE						
3-12	3-44	DOPPLER/NWDC INTERFACE						
3-16	3-58	PMDS/NWDC INTERFACE						
3-17	3-61	WEAPON RELEASE						
3-18	3-67	MRI						

Figure A-10. Systems Test Operational Checklist

SECTION VI - IMS DRIFT CHECK AND AUTO-CALIBRATION

1.0 INTRODUCTION.

1.1 The Inertial Measurement Set (IMS) In-place Inertial Navigation Check (drift check) shall be performed to determine if the IMS performance is within the limits required for accurate navigation and weapons delivery. The land-based IMS auto-calibration procedure shall be performed to update the Inertial Measurement Unit (IMU) north and east gyro parameters only.

2.0 SPECIAL TOOLS AND TEST EQUIPMENT.

2.1 No special tools or test equipment are required.

3.0 DETAILED REQUIREMENTS.

3.1 The drift check and auto-calibration procedures shall be performed in accordance with procedures contained in NAVAIR 01-45AAE-2-11 (to NWC Standards).

3.2 DOCUMENTATION.

3.2.1 The drift check and auto-calibration results shall be recorded on a data sheet provided for this purpose. Out-of-tolerance data shall be identified by circling in red. If a run is terminated prior to completion, a notation to that effect shall be entered on the form at the point of termination. Each run shall be documented separately. Figure A-11 illustrates a typical data sheet.

3.2.2 Failures and malfunctions of ALOFT-related systems and ALOFT components shall be documented as described in Section III.

3.2.3 A MAF shall be prepared to document all failures and malfunctions of aircraft components. Where applicable, MAF numbers shall be cross-referenced to the applicable checklist item number and the ALOFT Engineering Report Log entry number.

DRIFT CHECK & AUTO CAL

DATE_____ AIRCRAFT BUNO_____

IMU SER NO._____ A/PS SER. NO._____ NWDC SER NO._____

IMU ETM_____ A/PS ETM_____ NWDC ETM_____

ORIGINAL

01

02

03

1st AUTO CAL

01

02

03

TIME	LATITUDE			LONGITUDE			HEADING	
	0	1	11	0	1	11	0	1
00 min								
05								
10								
15								
20								
25								
30								
35								
40								
45								
50								
55								
60								
Change								

2nd AUTO CAL

01

02

03

3rd AUTO CAL

01

02

03

Figure A-11. Drift Check and Autocal Record (Sheet 1 of 2)

A-7E PROJECTS (CODE 40408)
NAVAL WEAPONS CENTER
CHINA LAKE, CALIFORNIA

Aircraft BUNO _____

IMU Ser No. _____

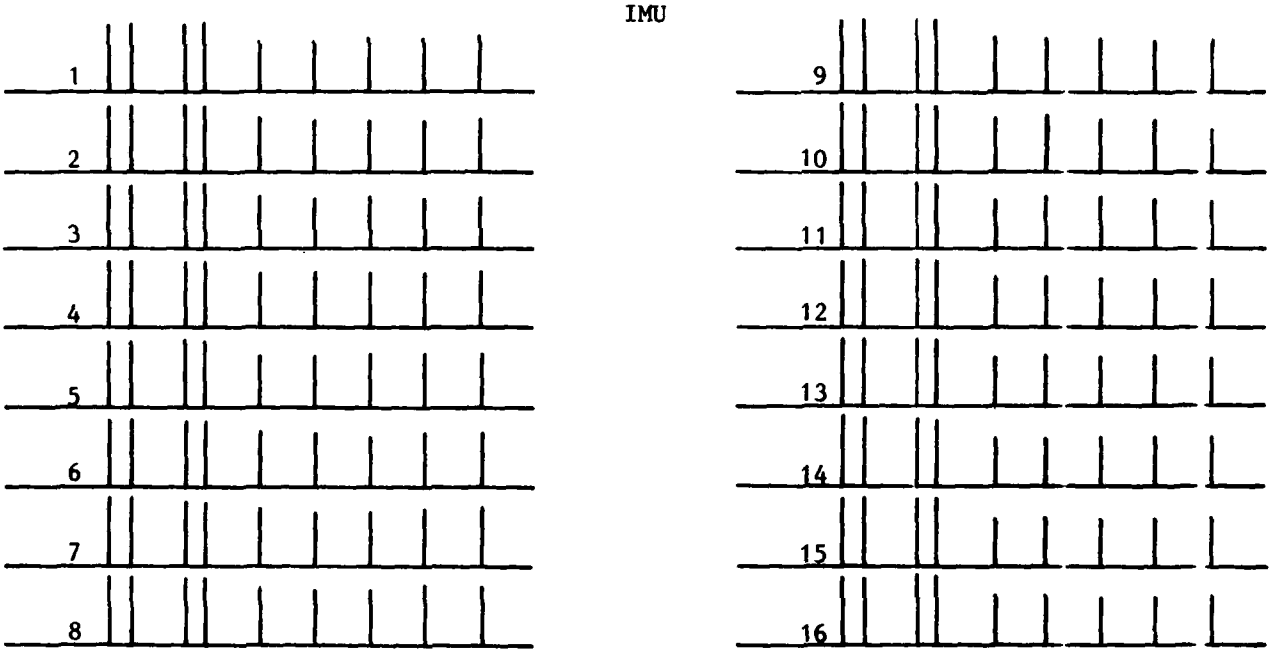
A/PS Ser No. _____

DRIFT CHECK AND AUTO CAL

ASN-91 Ser No. _____

DATE _____

IMU



PMDS

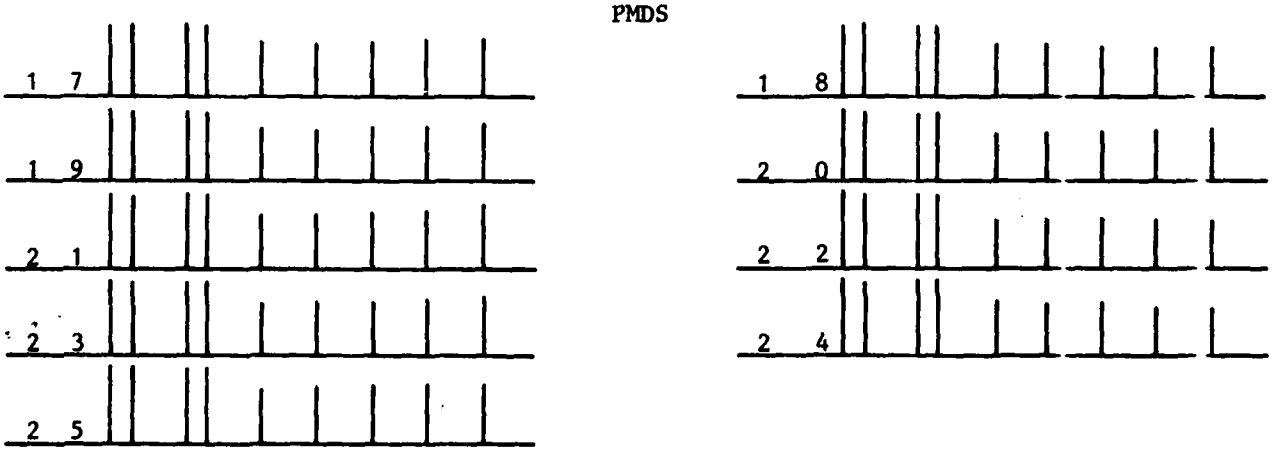


Figure A-11. Drift Check and Autocal Record (Sheet 2 of 2)

SECTION VII - PROJECT TEST

1.0 INTRODUCTION.

1.1 The project test shall include various special tests of instrumentation systems and other tests as the project engineer may direc .

2.0 SPECIAL TOOLS AND TEST EQUIPMENT.

2.1 No special tools or test equipment are required.

3.0 DETAILED REQUIREMENTS.

3.1 All ALOFT project test requirements have not yet been determined. Additional requirements will be added as required.

3.2 Initially, after assignment of an aircraft to a project, a test tape should be pulled to verify operation of the flight recorder. On this project, however, three computer configurations will be used. Therefore, a test tape shall be pulled, and the operation verified, after each installation and each grooming flight.

3.3 DOCUMENTATION.

3.3.1 A checklist of all items to be accomplished shall be required. The checklist shall list the items in the order in which they must be performed. Figure A-12 illustrates a typical checklist.

3.3.2 Failures and malfunctions of ALOFT-related systems and ALOFT components shall be documented as described in Section III.

3.3.3 A MAF shall be prepared to document all failures and malfunctions of aircraft components. Where applicable, MAF numbers shall be cross-referenced to the applicable checklist item number and the ALOFT Engineering Report Log entry number.

PROJECT TEST CHECKLIST				
TEST No.	TEST DESCRIPTION	CONFIGURATION		
		FL	COP	/O
1.	Check Project Tone	X	X	X
2.	Check Tape Recorder Operation	X	X	X
3.	Insure proper tape (OFP 01-11-3) is installed in the aircraft (special tape (01-11-3 ALOFT) for ALOFT computer)	X	X	X
4.	Pull test tape and check for good data	X	X	X
5.	Process the tape thru data reduction and deliver to A7 System Engineering. Data to be recorded shall be:	X	X	X
	a. Manual Ripple Releases MK-76 (XHR) b. Computed Releases MK-75 (XHR)			
	NOTE: Each operation should contain mixed station (MER to Parent) transfer test			
	(Singles, Qty. 7, 2 & 7 selected, MER on 7) (Singles, Qty. 7, 2 & 7 selected, MER on 2)			
6.	Analog zero adjustments (ALOFT)			X
7.	Strip off analog channels (ALOFT)			X
8.	Check timing marks vs ALOFT signals (ALOFT)			X

Figure A-12. Project Test Checklist

SECTION VIII - GROOMING FLIGHTS

1.0 INTRODUCTION.

1.1 The grooming (radar and navigation evaluation) flights are systems verification flights. These tests shall be conducted after the cursory validation (40-hour safety-of-flight check) has been completed.

1.2 The pre-demonstration validation evaluates three computer configurations and two software configurations. Two of the computer configurations are "new", as is one of the software (OFP/OTP) configurations.

2.0 SPECIAL TOOLS AND TEST EQUIPMENT.

2.1 No special tools or test equipment are required.

3.0 DETAILED REQUIREMENTS.

3.1 The grooming flights shall follow existing format for radar and navigation evaluation flights which are essentially Navigation/Weapons Delivery System (NWDS) checks.

3.2 DOCUMENTATION.

3.2.1 Instructions for the pilot (pilot's knee cards) for navigation and radar evaluation flights shall be in the format shown in Figures A-13 and A-14, respectively. On these forms are recorded the various details of each flight and pass the pilot is to make.

3.2.2 The A-7E flight record data shall be in the format shown in Figure A-15. This form is used to prescribe data reduction requirements.

3.2.3 Flight test information shall be documented in the format shown in Figure A-16. This form contains data recorded by flight test personnel who are in radio contact with the pilot during the flight. This sheet provides a preliminary estimate of bombing accuracy.

3.2.4 All discrepancies noted by the pilot shall be documented on the Organizational Discrepancy Register (OPNAV Form 4790/1), which is illustrated in Figure A-17. Discrepancies pertaining to the weapons system shall also be recorded on the Weapons System Debriefing Form. The debriefing form illustrated in NAVAIR 01-45AAE-2-17.2 may be used.

3.2.5 Failures and malfunctions of ALOFT-related systems and ALOFT components shall be documented as described in Section III.

3.2.6 A MAF shall be prepared to document all failures of aircraft components. Where applicable, MAF numbers shall be cross-referenced to the applicable checklist item number and the ALOFT Engineering Report Log entry number.

NORTH-EAST NAV FLIGHT

DATE_____PILOT_____TAPE #_____

FLT #_____DATA #_____

NAV HOP

I ALIGNMENT SEQUENCE

II TAKE OFF CONDITION

IMS -

DOPP -

RAD ALT -

FLR -

DATA 24

DATA 25

Figure A-13. Pilot's Instruction Sheet, Navigation Evaluation Flight (Sheet 1 of 7)

2

III END OF RUNWAY

Data 92_____

Data 93_____

Data 95_____

Data 96_____

Data 97_____

Data 98_____

TAKE OFF TIME_____

Figure A-13. Pilot's Instruction Sheet, Navigation Evaluation Flight (Sheet 2 of 7)

3

DATE _____

NORTH-EAST NAV ROUTE

DEST #1 NID

N 35 41 33

2250'

W 117 41 08

DEST #2 4 CORNERS TIME _____

N 34 59 32

2475'

W 117 32 26

_____ _____ FLYOVER _____

_____ _____ _____

DEST #3 DAGET TACAN TIME _____

N 34 57 45

1930'

W 116 34 38

_____ _____ FLYOVER _____

_____ _____ _____

Figure A-13. Pilot's Instruction Sheet, Navigation Evaluation Flight (Sheet 3 of 7)

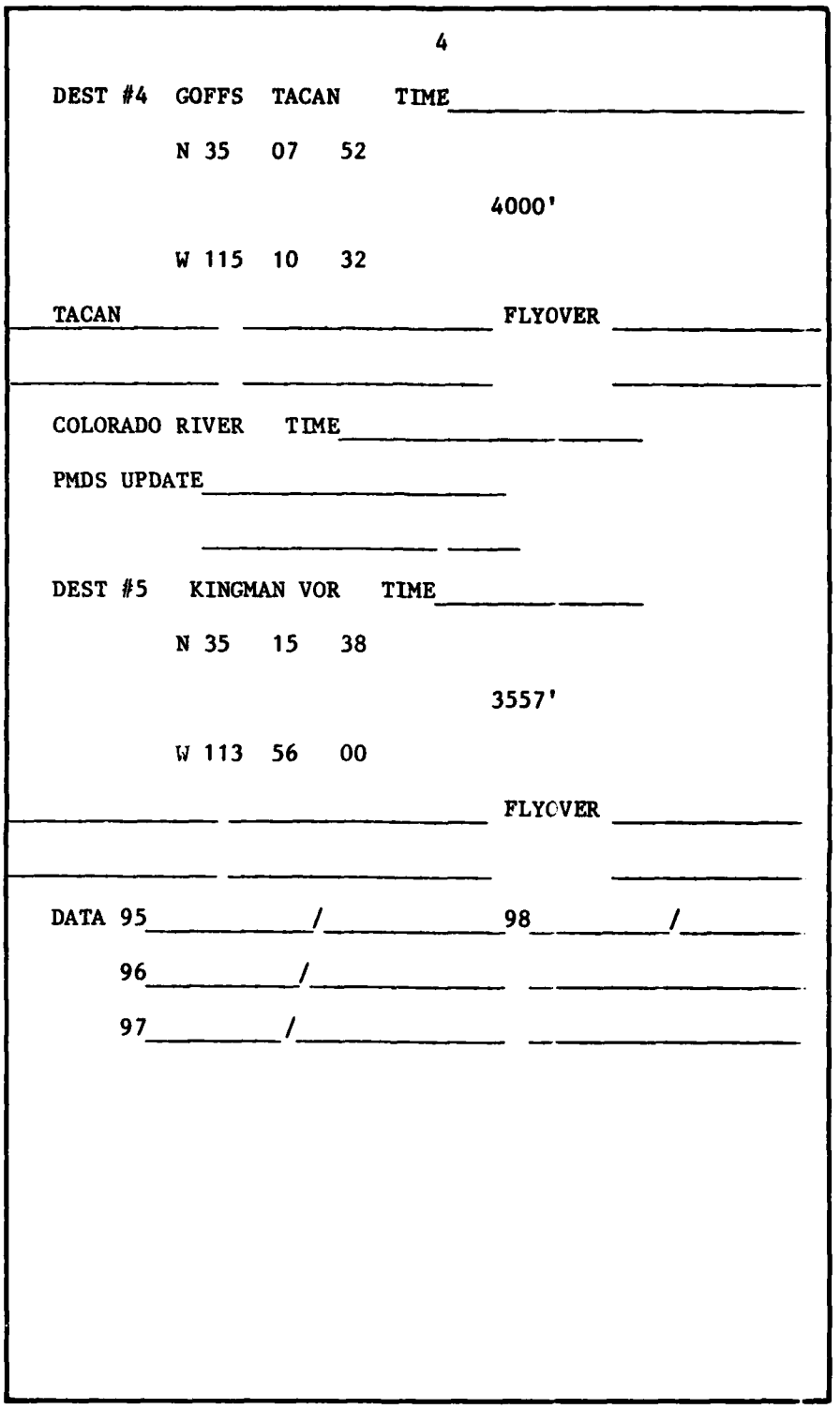


Figure A-13. Pilot's Instruction Sheet, Navigation Evaluation Flight (Sheet 4 of 7)

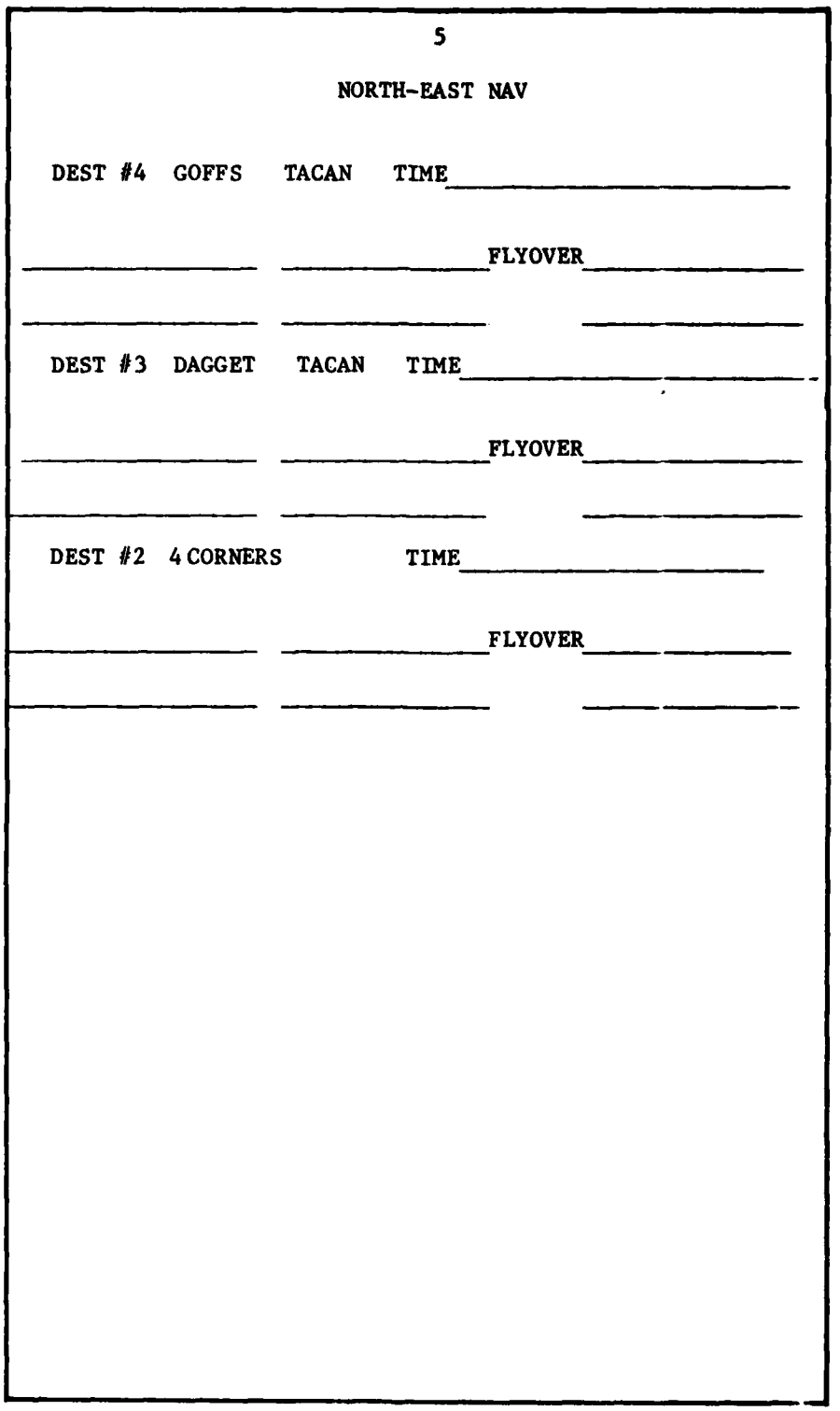


Figure A-13. Pilot's Instruction Sheet, Navigation Evaluation Flight (Sheet 5 of 7)

6

NORTH-EAST NAV

DEST #6 HAIWEE PYLON TIME_____

N 36 08 21

3759'

W 117 57 08

_____ _____FLYOVER_____ _____

_____ _____ _____ _____

DEST #7 ROAD INT (BIG PINE) TIME_____ _____

N 37 10 45

4000'

W 118 14 30

_____ _____FLYOVER_____ _____

_____ _____ _____ _____

DATA 95_____/_____98_____/_____

96_____/_____ _____

97_____/_____ _____

Figure A-13. Pilot's Instruction Sheet, Navigation Evaluation Flight (Sheet 6 of 7)

7

NORTH-EAST NAV

DEST #6 HAIWEE PYLON TIME_____

_____ _____FLYOVER_____

_____ _____ _____

DOPP

DEST #1 NID TIME_____

END OF RUNWAY

DATA 92_____/_____

93_____/_____

95_____/_____

96_____/_____

97_____/_____

FINAL PRES POS ___ _____

_____

Figure A-13. Pilot's Instruction Sheet, Navigation Evaluation Flight (Sheet 7 of 7)

WEAPONS FLIGHT

PILOT_____ DATE_____

FLT #_____ A/C #_____

PURPOSE_____

PRE-TAKE-OFF

1. Ground Align
2. Inertial

TIME CODE GEN.

TAKE-OFF CONDITION

IMS - Inertial

DOPP -

RAD ALT -

FLR -

DATA 24

DATA 25

QUAN -

INT -

SINGLES/PAIRS

ASCU

1 + 8 -

2 + 7 -

3 + 6 -

Figure A-14. Pilot's Instruction Sheet, Radar Evaluation Flight (Sheet 1 of 4)

2

DEST CARD

DEST #1 NID

N 35° 41' 33"

2250'

W 117° 41' 08"

DEST #2 BIC

N 35° 46' 13"

W 117° 47' 28"

ACTUAL TGT ALT 2260'

ALT_____

MSLP_____

DEST #3 BIC

ALT_____.

MSLP_____.

DEST #4 BIB

N 35° 46' 18"

ALT_____.

W 117° 47' 11"

MSLP_____.

ACTUAL TGT ALT 2256'

RNG/BRG From BIB to BIC

1500' / 252° 12' 19"

Figure A-14. Pilot's Instruction Sheet, Radar Evaluation Flight (Sheet 2 of 4)

3 CONDITIONS				
SYSTEMS	I	II	III	IV
IMS				
FLR				
RAD ALT				
DOPP				
DATA 24				
DATA 25				
QTY				
INT				
SING/PAIRS				
STA #				
ATT MODE				
REL MODE				
RNG/BRG				
ΔH/BH				
UPDATE #				
REMARKS				

Figure A-14. Pilot's Instruction Sheet, Radar Evaluation Flight (Sheet 3 of 4)

4

DELIVERY DATA

ROLL IN ALT (MSL)_____

BOMB #	PASS #	DIVE ANGLE	DEST #	COND #	REMARKS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					

Figure A-14. Pilot's Instruction Sheet, Radar Evaluation Flight (Sheet 4 of 4)

A-7E FLIGHT RECORD

FLIGHT NO._____ TEST PLAN_____ DATE_____

PILOT_____ RANGE_____ AIRCRAFT_____

TYPE & PURPOSE_____

_____

COMPUTER PROGRAM & HANDLOADS USED

PROJECT ENGINEER_____ NWC #1 ☐ _____ NWC #1A ☐ _____

NWC #2 ☐ _____ OTHER ☐ _____

INSTRUMENTATION

AIRCRAFT: FLIGHT RECORDER ☐ HUD CAMERA ☐ TIMING ☐

TIME SCHEDULED_____ ACTUAL TIME_____ _____

RANGE DATA RADAR ☐ _____ COMPUTER ☐ _____

SPOTS & PLOTS ☐ RADAR PLOTS ☐ O-GRAPH ☐ OTHER ☐ _____

RADIOSONDE (29.92) ☐ _____

ORDNANCE TYPE & QUALITY_____

REQUESTED TAPE REDUCTION DATE - J.O._____ TAPE SPEED 15 ips 30 ips

WEAPONS ☐ (a) ACCURACY ☐ ISEC LISTING ☐ OTHER_____

(b) INTERVAL ☐ NAV ANALYSIS ☐

TRACK	FUNCTION	TRACK	FUNCTION
2		1	
4	IKz Release Tone	3	
6	Bomb Release	5	
8	DATA READY	7	
10	DATA	9	
12	Clock	11	
14	IRIB "B" Timing	13	

REMARKS:_____

_____

_____

_____

Figure A-15. A-7E Flight Record

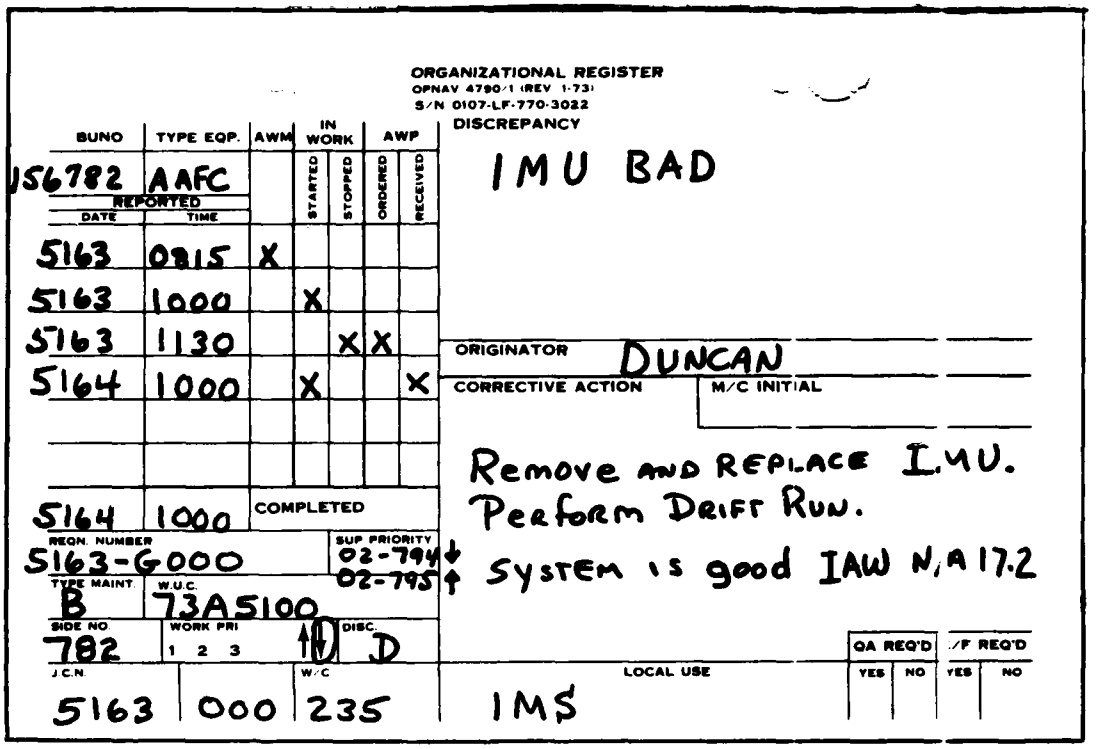
FLIGHT TEST INFORMATION SHEET

FLT #_____ PILOT_____ DATE _____

RANGE_____ A/C_____ ORDNANCE_____

RANGE PASS	TAPE FILE	DIVE ANGLE	RANGING MODE	DEST	COND	TONE	HIT ESTIMATE	BOMB NO.	REMARKS
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		
							AZ / RN		

Figure A-16. Flight Test Information Sheet



ORGANIZATIONAL REGISTER
OPNAV 4790/1 (REV 1-73)
S/N 0107-LF-770-3022

BUNO	TYPE EQP.	AWM	IN WORK		AWP	
156782	AAFC		STARTED	STOPPED	ORDERED	RECEIVED
REPORTED DATE	REPORTED TIME					
5163	0815	X				
5163	1000		X			
5163	1130			X	X	
5164	1000		X			X
5164	1000	COMPLETED				

DISCREPANCY: IMU BAD

ORIGINATOR: DUNCAN

CORRECTIVE ACTION: Remove and replace IMU. Perform drift run. System is good IAW NA 17.2

M/C INITIAL:

REQN. NUMBER: 5163-G000
SUP PRIORITY: 02-794 / 02-795
TYPE MAINT.: B
W.U.C.: 73A5100
SIDE NO.: 782
WORK PRI: 1 2 3 — 1
DISC.: D
J.C.N.: 5163 000
W/C: 235
LOCAL USE: IMS

QA REQ'D		/F REQ'D	
YES	NO	YES	NO

Figure A-17. Organizational Discrepancy Register

APPENDIX "B"

BASELINE FLIGHT PLAN

1.0 PURPOSE

1.1 The Baseline Flight Plan is an itegral part of the stated goals of the ALOFT Demonstration Program. Baseline flights have taken on primary significance because two new computers and a modified OTP/OTP have been introduced into the Weapon System. Since there are no data bases for these computers, baseline flights are imperative.

2.0 SCOPE

2.1 Data will be obtained from the same (or as close to the same as possible) points for each of three configurations. By comparison of baseline data collected in each configuration, the effectiveness of the ALOFT modification will be determined. The baseline flight data will be collected by performing the following tasks:

a. Flying baseline flights as required in the Fleet configuration to ascertain "normal" operation and to obtain an aircraft "footprint."

b. Flying baseline flights as required in the ALOFT/COPPER configuration. Flights will match the "footprint" established in Fleet configuration flights.

3.0 METHOD OF ACCOMPLISHMENT

3.1 Baseline flight testing will be conducted in two phases. Phase I consists of navigation flights; Phase II consists of weapons delivery flights. Baseline flights will be conducted after the laboratory and ground test protions of the pre-demonstration verification effort have been completed. Extensive baseline flight testing is required because two new computers are being used and no empirical data pertaining to the operation of these computers in an

aircraft environment currently exists. The Baseline Flight Test Program will verify that moding is correct and that computation accuracy for both navigation and weapons delivery is within acceptable limits.

3.2 The Baseline Flight Test Program is oriented towards exercising the various modes of the weapons delivery system to gather data regarding system operation in the Fleet, ALOFT/COPPER, and ALOFT/FIBER OPTIC configurations. When this data has been collected, it will be used to compare the operational feasibility of utilizing fiber-optic interfaces in lieu of copper wire interfaces. Because the differences in the ALOFT OFP and the Fleet OFP will be minor, determination of ALOFT computer accuracy will be determined in the laboratory. Therefore, extensive flight testing for that purpose is not required.

3.3 Baseline weapons flights will be conducted using the NWC instrumented ranges. Range data will be correlated with data from the aircraft flight recorder to obtain usable data from which analyses of system moding, computation accuracy, and sensor control can be made. Where applicable, data will be presented in correlated summaries that reflect system accuracy.

3.4 PHASE I - NAVIGATION FLIGHTS. The flights to be performed to evaluate navigation functions are listed in Figure B-1. Each navigation flight will be flown over a predetermined route with good visual and radar update points. Flights will be approximately 2.5 hours in duration and wind checks will be made in each leg of the flight. Updates will be performed every 10 to 15 minutes. The flights are structured to test navigation system operation under various alignment and mode conditions.

FLIGHT NO.	TYPE	NAV MODE	TYPE ALIGNMENT
1	North-East	I	Complete ground alignment (To be flown only if funds are available)
2	North-East	I/DIG	Complete ground alignment
3	North-East	DIG	Coarse leveling complete; airborne alignment
4	North-East	DIG	Coarse gyrocompassing only; airborne alignment (To be flown only if funds are available)
NOTE: All updates will be functionally checked on each flight. Wind and Doppler checks will also be made.			

Figure B-1. Navigation Test Flights

3.4.1 As each navigation test flight is completed, an entry to that effect will be made on the Navigation Test Flight Data Sheet shown in Figure B-2. Discrepancies noted will be recorded on the appropriate record sheets.

3.4.2 The direction and amount of navigation error noted for each flight will be recorded on the form illustrated in Figure B3. Present position error at the midpoint of the flight and upon landing will be recorded on this data sheet.

3.4.3 Present position error will be determined at regular intervals throughout each flight. Figure B-4 illustrates the Update Mode Accuracy Data Sheet. On this form, the difference in present position error that exists between a flyover update and the update method specified on the data sheet will be recorded. Differences (deltas) will be presented in seconds of present position error along and across the aircraft ground track and will be averaged values.

FLIGHT No.	NAV MODE	TYPE ALIGN	START DATE	COMPL DATE	AIRCRAFT CONFIG.			DISCREPANCIES NOTED / REMARKS	MAF/ALOFT LOG No.
					F	AC	FO		

Figure B-2. Navigation Test Flight Data Sheet

NAV MODE	ALIGNMENT	TOTAL FLT TIME		LANDING ERROR			MIDPOINT UPDATE ERROR		
		HR	MIN	DIR	MIN	SEC	DIR	MIN	SEC

Figure B-3. Navigation Accuracy Data Sheet

UPDATE MODE	RANGING	NAV MODE	Δ ON TRACK, (SEC)	Δ CROSS TRACK (SEC)	NO. OF SAMPLES
HUD	FLR	PRIME			
HUD	BARO	PRIME			
HUD	RAD ALT	PRIME			
RADAR	BARO	PRIME			
RADAR	RAD ALT	PRIME			

Figure B-4. Update Mode Accuracy Data Sheet

3.4.4 Wind checks will be performed and recorded during each navigation flight by performing a box pattern at constant altitude and noting the wind velocity and bearing at each cardinal heading. Wind computation data will be recorded on the data sheet illustrated in Figure B-5.

FLT NO.	IMS MODE	ALIGNMENT	WIND VELOCITY & DIRECTION			
			0°	90°	180°	270°

Figure B-5. Wind Velocity Data Sheet

3.5 PHASE II - WEAPONS DELIVERY FLIGHTS. Weapons delivery flights will be flown to verify conventional weapons delivery computations and moding, and operation of the minimum release interval (MRI) structure.

3.5.1 MRI evaluation flights will be flown to test the accuracy of the MRI equation computations and moding. The flights will be structured to test each MRI class for accuracy of the MRI computations at different

values of normal acceleration. The moding will be checked to verify that the proper MRI class is selected by the OFP according to the ASCU code, retard switch for pilot option weapons, number of stations selected, and the quantity thumbwheel setting, for conditions concerning automatic reversion to the Class II (safe MRI) feature.

3.5.2 The MRI flights will be evaluated by noting the interval and pulse width of the recorded fire release pulses from the computer and by comparing this interval with the MRI equation for the value of normal acceleration recorded at release. The interval between fire release pulses should be as programmed with no discernible error.

3.5.3 A description of the conventional weapons flights is presented in Figure B-6.

3.5.4 A description of the MRI evaluation flights is presented in Figure B-7.

4.0 DOCUMENTATION

4.1 Compiletion of each of the required baseline conventional weapons and MRI evaluation flights will be recorded on the form illustrated in Figure B-8. Discrepancies will be recorded on the appropriate record sheets.

Flight/ Pass No.	Wpn/ASCU	Rack/Sta	Qty/Int (ft)	Attack	Del. Mode	Nav. Mode	Ranging	Remarks/ Loading
5 & 6/ Pass 1	Mk76/XHR	MER/2 & 7	01/010'	Normal	45-degree St Path	Inertial	FLR	
Pass 2	"	"	"	"	"	"	BARO	
Pass 3	"	"	"	"	Dive Toss	Inertial	FLR	
Pass 4	"	"	"	"	"	"	BARO	
Pass 5	"	"	"	"	St Path	DIG	FLR	
Pass 6	"	"	"	"	"	"	BARO	
Pass 7	"	"	"	"	Dive Toss	DIG	FLR	
Pass 8	"	"	"	"	"	"	BARO	
Pass 9	"	"	"	"	St Path	DIG	RAD ALT	
Pass 10	"	"	"	"	"	Inertial	"	
Pass 11	"	See Loading	03/010'	Manual Ripple	Level	I	N.A.	Fully loaded MER's Stations 1, 8, 2 & 7
Pass 12	"	"	03/300'	"	St Path	IMS FAIL	"	

FIGURE B-6. Conventional Weapons Flight Matrix. (Sheet 1 of 2)

Flight/ Pass No.	Wpn/ASCU	Rack/ASCU	Qty/Int (ft)	Attack	Del. Mode	Nav. Mode	Ranging	Loading/Remarks
7/ Pass 1	Mk-76/ XHR	MER/STA 2 & 7	01/010'	Normal	St Path 45° Dive	I	FLR	
Pass 2	"	"	"	"	"	"	RAD ALT	
Pass 3	"	"	"	"	"	DIG	FLR	
Pass 4	"	"	"	Normal Offset	Level 200'-500' AGL	"	BARO	
Pass 5	"	"	"	Radar Offset	"	I	BARO	
Pass 6	"	"	"	Nav with Update	"	"	RAD ALT	
Pass 7	"	"	01/010'	Normal Offset	St Path 45° Dive	I	FLR	
Pass 8	"	"	01/010'	Radar	"	I	RAD ALT	
Pass 9	"	"	01/010'	Nav with Update	"	DIG	FLR	
Pass 10	"	"	01/200'	Radar Offset	"	DIG	FLR	

Figure B-6. Conventional Weapons Flight (Sheet 2 of 2)

Flight/ Pass No.	WPN/ASCU Code	Qty/ Int. (ft)	Rack/ Stations	Del. Mode	Attack Mode	g	MRI Class	Loading/Remarks
8/Pass 1	Mk 82 LDGP/ XGO	03/010'	Parent 1, 8, 2	St Path	Normal	<1	III	MRI Class I, 6 Mk 82 on all parent stations.
Pass 2	"	"	Parent 7, 3, 6	Dive Toss	Normal	>2	III	
9/Pass 1	Mk 76 XHR	"	2 MER	Dive Toss	Normal	>2	I, II	6 Mk 76 on MER STA 2. 6 Mk 106 on MER STA 7.
Pass 2	"	"	"	St Path	"	<1	"	
Pass 3	Mk 106 XHP	"	7 MER	"	"	<1	"	
Pass 4	"	"	"	Level	Manual Ripple	1	"	
10/Pass 1	Mk 83 Con/ XGS	"	Parent-1, MER-7	St Path	"	<1	II Safety Feature	1 Mk 83 con on Parent 1 and 8, 2 Mk 83 con on MER's 2 and 7.
Pass 2	"	"	Parent-8,	Dive Toss	"	>2	"	" " " "

FIGURE B-7. MRI Weapons Flight MATRLX

FLIGHT No.	TYPE FLIGHT	AIRCRAFT CONFIG. F	AC	FO	START DATE	COMPL DATE	DISCREPANCIES NOTED/REMARKS	MAF/ALOFT LOG. No.

Figure B-8. Flight Data Sheet

Flight/ Pass No.	WPN/ASCU Code	Qty Int (ft)	Rack/ Station	Del. Mode	Attack Mode	g	Ranging Mode	Loading/Remarks
12/ Pass 1	Mk 106 XCM (Flares)	03/100'	1 & 8/MER	Level	Manual Ripple	1	BARO	6 ea Mk 106 on MER STA 1 & 8
Pass 2	"	03/50'	"	St Path 30-45°	Normal	<1	FLR	
Pass 3	"	"	"	Level	Nav Auto Update	1	RAD ALT	
Pass 4	"	24/300' (1725')	"	Level	"	1	BARO	

Figure D-9. Mining/Flares Flights Matrix (Optional)

APPENDIX "C"

ALOFT MODIFICATION INSTALLATION AND REMOVAL AND AIRCRAFT REVERIFICATION PLAN

1.0 PURPOSE

1.1 This plan provides the instructions and requirements for installing the ALOFT modification in the test bed aircraft, for removal of the modification after completion of the flight test, for returning the aircraft to the same configuration in which it was received, and for reverification of proper operation of all aircraft avionics systems after return to the "fleet" configuration.

1.2 To accomplish this task, some changes to the aircraft structure and wiring are required. To minimize these changes, some of the ALOFT cables have been made longer than the wiring harnesses they are replacing. This allows existing accesses to be used, markedly reducing the number of structural changes required. Maximum use of "T" cables to permit existing connectors to be used is an integral part of the design. This feature virtually eliminates the need for splicing.

2.0 SCOPE

2.1 The installation has been designed by Vought Systems Division of the LTV Aerospace Corporation, Dallas, Texas, under contract to the Naval Electronics Laboratory Center (NELC), San Diego, California. The effort of LTV included environmental analysis, wiring, and mechanical design.

The hardware necessary to perform the modification will be supplied to NWC by LTV/NELC in kit form. It is anticipated that minor discrepancies may arise that could necessitate NWC modifications to the kit. Drilling the required access holes, routing of wiring, installation of special connectors and installation of attaching hardware (nuts, bolts, clamps, etc.) will be the responsibility of NWC. Installation of fiber optic components will be the responsibility of IBM/NELC personnel. The guideline used by NWC is that all fabricated sheet metal parts will be provided by NECL.

3.0 METHOD OF ACCOMPLISHMENT

3.1 The ALOFT modification will be installed in A-7C aircraft BuNo. 156782. Prior to installation of the modification, Naval Air Facility, China Lake, (NAFCL) work center 235 personnel will remove various components as required. The modification will require sheet metal work in three areas, consisting of (1) the drilling of a hole in the bulkhead between the liquid oxygen compartment and the left avionics compartment, (2) the installation of a pressurized bulkhead fitting with six feedthroughs in the cockpit section, and (3) the mounting of five ALOFT adapters. Two of the adapters will be installed in the left avionics compartment, one in the right avionics compartment, one in the sweep generator compartment, and one in the cockpit. The work will be performed by NWC Code 3712 sheet metal shop personnel.

3.2 Six wiring harnesses will also be installed as part of the ALOFT modification. One harness will be installed in the right avionics compartment, two in the left avionics compartment, one in the sweep generator compartment, one in the cockpit, and one that is routed between the

right-hand circuit breaker panel and each of the five ALOFT adapters. This cable is used to provide power to each of the adapters. Electrical harnesses will be supplied by IBM and the work will be performed by NWC Code 3172 electrical shop personnel. Figure C-1 illustrates the locations of the ALOFT modification on the aircraft.

3.3 Fiber-optic components will be installed by NWC/IBM personnel under direction of NELC. This includes a new fiber optic connector on the TC-2 computer rack (J-10 location). This task will be accomplished concurrent with the NWC effort.

4.0 DETAILED REQUIREMENTS

4.1 INSTALLATION.

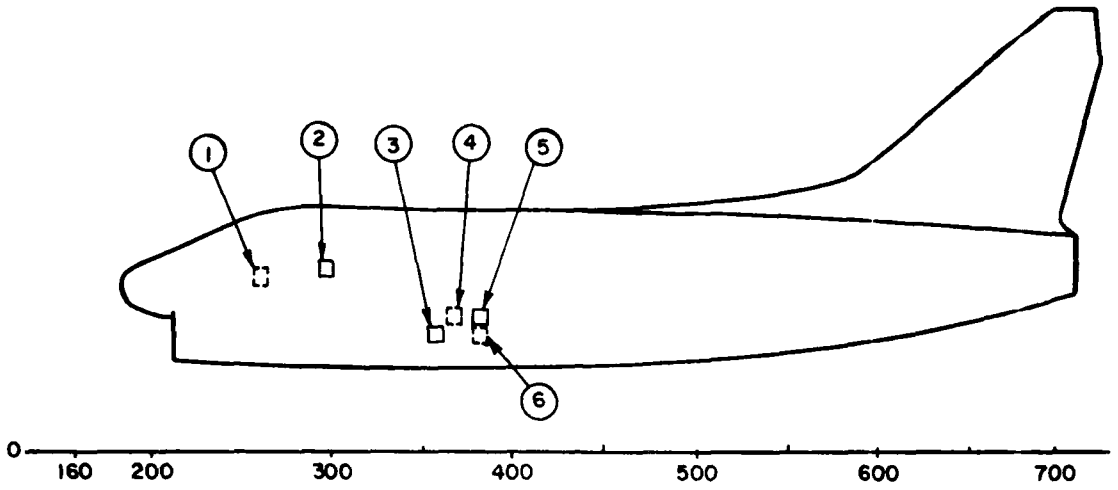
4.1.1 PREPARATION. To prepare aircraft for installation of the ALOFT modification, the following must be accomplished by personnel from NAFCL work center 235:

a. Remove from the right avionics compartment:

1. KIT1A/TSEC MK XII computer
2. R1286/ARR69 Receiver
3. KIT1A/TSEC Mounting Rack
4. MT3137/ARR69 Mounting Rack

b. Remove from the left avionics compartment:

1. AN/APR-25(V) Analyzer
2. 216-37409-58 Bracket Assembly
3. TC-2 Computer and Rack
4. ASCU and Rack



1. Fiber-Optic Adapter, Cockpit Area - Right-Hand Instrument Console (FS 264).
2. Fiber-Optic Adapter, Forward Looking Radar - Left Forward Mid Equipment Compartment (FS 297).
3. Fiber-Optic Adapter, Left Avionics Compartment - Fuselage Station 358 (FS 358).
4. Fiber-Optic Adapter, Right Avionics Compartment - Fuselage Station 371 (FS371).
5. Fiber-Optic Adapter, Armament Station Control Unit - Left Avionics Compartment (FS 380).
6. Fiber-Optic Instrumentation Package - Right Avionics Compartment (FS 383).

Figure C-1. ALOFT Modification, Component Location Diagram (Sheet 1)

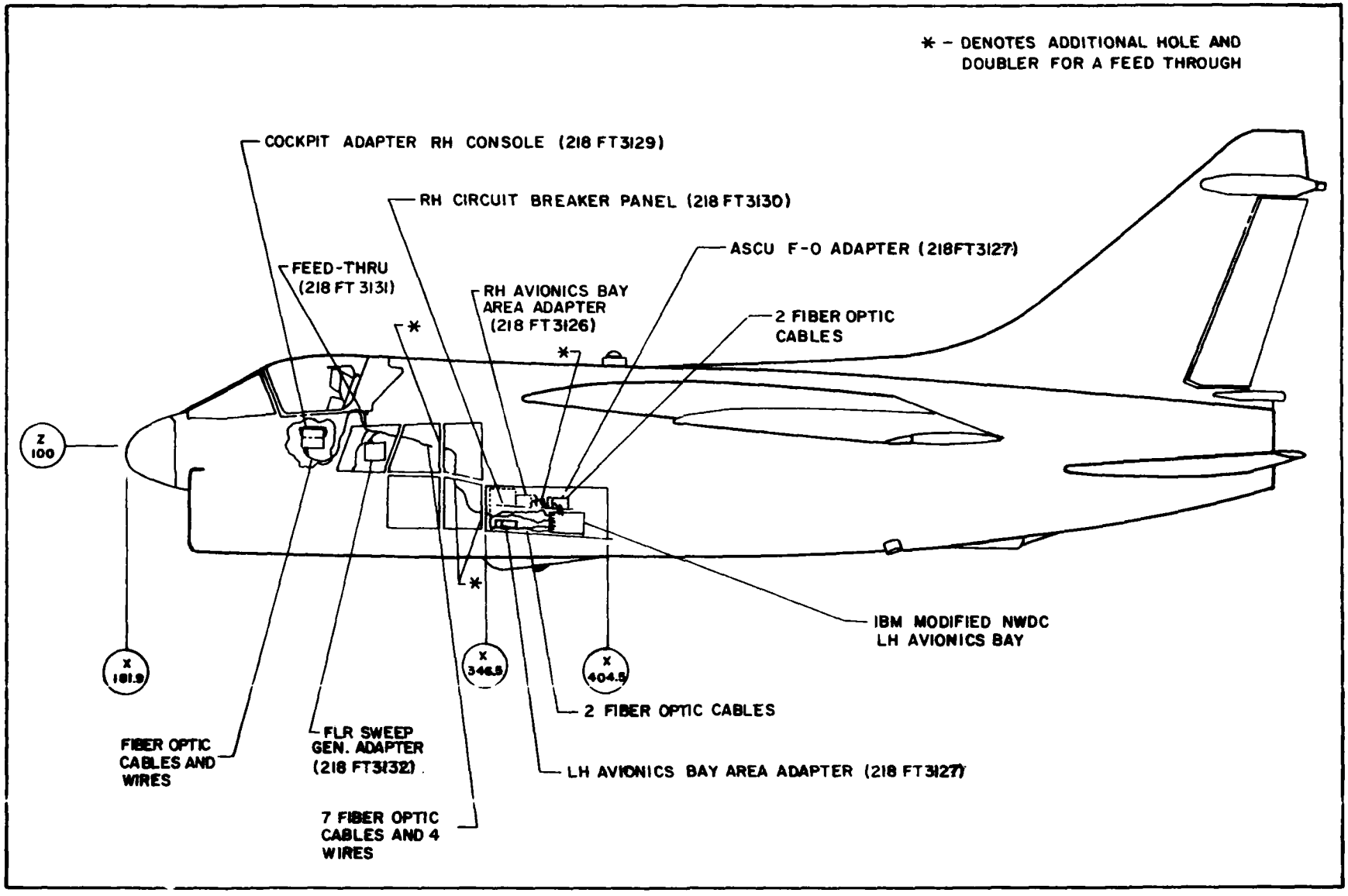


Figure C-1. ALOFT Modification, Component Location Diagram (Sheet 2)

c. Remove from the cockpit:

1. 218-21621-1 Map case
2. A9555-2 Light Assembly
3. CU 21-406537-2 Bracket
4. Various control boxes on the Right and Left Instrument Consoles as required for access.

d. Remove the sweep generator panel.

4.1.2 RIGHT AVIONICS COMPARTMENT AREA ADAPTER. The right avionics compartment adapter will be installed per LTV drawing 218FT3126 on the right avionics compartment shelf immediately forward of the Air Data Computer. After mounting the 218FT3126-119 clips to the 218FT3126-103 base plate, the base plate can be mounted to the shelf utilizing five existing fastener locations. The holes in the 218FT3126-119 clips for the shear pins should not be drilled until the mounting plate assembly has been fitted on the base plate; then the holes for the shear pin can be aligned properly. The right avionics compartment adapter box should not be installed until the mounting plate assembly has been fitted properly. During installation of the adapter box, be certain that the ground strap is properly installed. Three holes must be drilled in the shelf for installation of the mounting plate assembly. The shear pins on the mounting plate assembly must fully engage the 218FT3126-119 clips after installation. The hardware required to install this adapter is listed in Figure C-2.

Qty Reqd	Part No.	Nomenclature	Furnished By
1	218FT3126-103	Base plate - .125x9.6x12.6	NELC
1	218FT3126-107	Mounting plate assembly	NELC
1	218FT3126-115	Reinforcing strip	NELC
2	218FT3126-119	Clip	NELC
2	218FT3126-121	Spacer	NELC
8	218FT3126-127	Screw	NELC
1	L20-249-2	Adapter Box	IBM
12	AN 960 D8	Washer	NWC
6	AN 960 DIOL	Washer	NWC
12	MS 21042L08	Nut	NWC
5	MS 21042L3	Nut	NWC
3	NAS 464-3-15	Bolt	NWC
4	NAS 517-2-7	Screw	NWC
4	NAS 517-3-2	Screw	NWC
1	NAS 517-3-4	Screw	NWC
2	NAS 574-2	Shear Pin	NWC

Figure C-2. Hardware Requirements, Right Avionics Compartment Area Adapter Installation

4.1.3 LEFT AVIONICS COMPARTMENT AREA ADAPTER. The left avionics compartment area adapter will be mounted in the space provided for LORAN on the left avionics compartment floor per LTV drawing 218FT3127. The 218FT3127-119 clips should be mounted on the base plate before aligning the mounting plate assembly so that the shear pin holes can be drilled in the proper locations.

To mount the 218FT3127-113 base plate to the floor, three existing fastener locations will be utilized and one additional hole must be drilled through the floor. The mounting plate assembly should be fitted to the base plate before mounting the adapter box. The ground strap on the adapter box should be attached properly during installation. The shear pins on the mounting plate assembly must fully engage the 218FT3127-119 clips after installation. The hardware required to install this adapter is listed in Figure C-3.

4.1.4 ASCU ADAPTER. The ASCU adapter box will be mounted on the left avionics compartment shelf immediately forward of the ASCU. It should be mounted as shown on LTV drawing 218FT3127 in the same manner as the left avionics compartment area adapter. One additional hole must be drilled in the shelf to mount the base plate. Four existing fastener locations will also be used for mounting. Three holes must be drilled through the shelf to bolt the mounting plate assembly with attached adapter box to the shelf. On all installations on the avionics compartment floors or shelves, the new fasteners going through the metalite panel must be backed up by a reinforcement plate to prevent crushing of the balsam wood core panel. The hardware required to install this adapter is listed in Figure C-4.

4.1.5 FORWARD-LOOKING RADAR (FLR) ADAPTER. The FLR adapter box will be mounted in the forward left mid-equipment compartment, outboard of the sweep generator. The FLR adapter box will be attached to existing aircraft structure using a plate, brackets, and clips as shown on LTV drawing 218FT3132. All the detail parts should be installed on the aft bulkhead of the compartment (216-20024). Detail parts 218FT3132 -108, -109, and -111 should be

Qty Reqd	Part No.	Nomenclature	Furnished By
1	218FT3127-107	Mounting plate assembly	NELC
1	218FT3127-109	Mounting plate, .080x9.6x12.4	NELC
1	218FT3127-113	Base plate, .125.6x12.6	NELC
1	218FT3127-117	Reinforcing Pad, .125x1.3x1.3	NELC
2	218FT3127-119	Clip, .08x1.4x1.9	NELC
2	218FT3127-121	Spacer, .250x9.8x1.4	NELC
1	218FT3127-123	Spacer, .250x1.0x9.6	NELC
1	218FT3127-125	Spacer, .250x9.6x9.6	NELC
1	L20-249-3	Left Bay Adapter	IBM
12	AN960D8	Washer	NWC
1	AN960D10	Washer	NWC
6	AN960D10L	Washer	NWC
8	MS 20426AD4	Rivet	NWC
12	MS 21042L08	Nut	NWC
6	MS 21042L3	Nut	NWC
3	NAS 464-3-8	Bolt	NWC
4	NAS 517-2-7	Screw	NWC
3	NAS 517-3-9	Screw	NWC
1	NAS 517-3-11	Screw	NWC
2	NAS 574-2	Shear Pin	NWC

Figure C-3. Hardware Requirements, Left Avionics Compartment Area Adapter Installation

Qty Reqd	Part No.	Nomenclature	Furnished By
1	218FT3127-107	Mounting Plate assembly	NELC
1	218FT3127-111	Base Plate, .125x9.6x12.6	NELC
1	218FT3127-115	Reinforcing Strip, .125x1.0x9.6	NELC
2	218FT3127-119	Clip, .080x1.4x1.9	NELC
1	218FT3127-117	Reinforcing pad,.125x1.3x1.3	NELC
2	218FT3127-121	Spacer, .250x0.8x1.4	NELC
8	218FT3127-127	Screw	NWC
1	L20-249-1	ASCU Adapter box	IBM
12	AN960 D8	Washer	NWC
1	AN960 D10	Washer	NWC
6	AN960 D10L	Washer	NWC
12	MS 21042L08	Nut	NWC
6	MS 21042L3	Nut	NWC
3	NAS 464-3-15	Bolt	NWC
4	NAS 517-2-7	Screw	NWC
4	NAS 517-3-2	Screw	NWC
1	NAS 517-3-11	Screw	NWC
2	NAS 574-2	Shear Pin	NWC

Figure C-4. Hardware Requirements, ASCU Adapter Installation.

installed on the forward bulkhead of the compartment. The five holes for mounting the 218FT3132-103 plate should be drilled through the plate and the mounting brackets at the same time, because of the close tolerances required on the holes. After the holes have been drilled in the plate, the nutplates can be mounted. The adapter box should then be mounted on the plate and the assembly installed in the airplane. Care should be taken to ensure proper electrical grounding for the adapter box. The hardware required to install this adapter is listed in Figure C-5.

4.1.6 COCKPIT ADAPTER. The cockpit adapter box will be mounted in the map case slot in the right-hand instrument console in the cockpit, as shown in LTV drawing 218FT3129. The canopy release handle, which is attached by a single bolt, must be moved prior to installation and reinstalled after the installation has been completed. A heat shield must be installed on the adapter box per LTV drawing 218FT3129. The hardware required to install this adapter is listed in Figure C-6.

4.1.7 AIRCRAFT STRUCTURAL REWORK. A one-inch (1") hole will be drilled on bulkhead station 346.5, between the liquid oxygen (LOX) compartment and the left avionics compartment. A one-inch (1") hole will also be drilled on the bulkhead between the LOX and mid-equipment compartments where space will allow. Five 15/32-inch holes and one 17/32-inch hole will be drilled and a doubler installed per LTV drawing 218FT3131. Where specified on the applicable drawings, MIL-58802 Sealing Compound, MIL-C-81706 Alodine, MIL-P-8505 Zinc Chromate Primer, and/or MMMA 189 Adhesive will be applied to ensure aircraft integrity and safety of flight.

Qty Reqd	Part No.	Nomenclature	Furnished By
1	CUC4991B140A	Bracket (See Note 1)	
1	L20-248	FLR Adapter Box	IBM
7	Nas 464-3-3	Bolt	NWC
14	MS 20426AD3	Rivet	NWC
2	MS 20600AD5-2	Rivet	NWC
6	MS 20470AD5	Rivet (estimated quantity)	NWC
8	MS 35190-258	Screws	NWC
7	MS 21075-L3	Nutplate	NWC
8	MS 21042-08	Nut	NWC
7	AN960D10L	Washer	NWC
8	AN960D8L	Washer	NWC
1	218FT3132-112	Gusset,.063x0.7x0.7	NELC
1	218FT3132-111	Angle Bracket,.063x1.6x2.7	NELC
1	218FT3132-110	Angle Bracket, .063x1.5x3.2	NELC
1	218FT3132-109	Channel, .063x5.2x2.2	NELC
1	218FT3132-108	Channel, .063x3.5x2.4	NELC
1	218FT3132-107	Channel, .063x3.5x3.2	NELC
2	218FT3132-106	Gusset, .063x1.1x2.4	NELC
1	218FT3132-105	Z Bracket Assembly	NELC
1	218FT3132-104	Z Bracket, .063x5.1x2.1	NELC
1	218FT3132-103	Plate, .125x13.1x10.5	NELC

Notes: (1) This item must be relocated.

Figure C-5. Hardware Requirements, FLR Adapter Installation

Qty Reqd.	Part No.	Nomenclature	Furnished By
1	L20-263	Adapter box	IBM
6	AN960D10L	Washer	NWC
6	NAS623-3-8	Screw	NWC
1	218FT3129-101	Heat Shield Assembly	NELC
1	CU21-406537-2	Bracket (See Note 1)	
1	A9555-2	Light Assembly (See Note 1)	
1	218-21621-1	Map Case (See Note 1)	

Notes: (1) This item must be removed.

Figure C-6. Hardware Requirements, Cockpit Adapter Installation

4.1.8 ROUTING OF WIRING HARNESS. All wiring harnesses will be provided by LTV and installed by Code 3172 electrical shop personnel. Power lines will be terminated in the right-hand circuit breaker panel. The ALOFT wiring harnesses will be routed along existing wire bundles and clamped as necessary to ensure a safe installation. If fiber-optic lines are congruent to the wire bundles, only wide plastic will be used to secure the wire bundles. Wire harness installation requirements are specified on LTV drawing 218FT3067.

4.2 REMOVAL

4.2.1 After the ALOFT flight test program is completed, the ALOFT modification will be removed by IBM/NELC personnel. The aircraft will then be returned to the configuration in which it was received, utilizing NAFCL work center 235 and NWC Code 3712 sheet metal shop personnel to perform these tasks.

4.3 REVERIFICATION.

4.3.1 After the aircraft has been restored to the "fleet" configuration, all avionics systems will be checked for proper operation in accordance with NAVAIR 01-45AAE-2-17.2.

4.4 WEIGHT AND BALANCE. The weight added to the aircraft for this installation is 105 pounds. To make room for the added equipment, 251 pounds of production equipment is removed from the aircraft. The resulting total weight change is -146 pounds which causes an aft center of gravity (C.G.) shift to the aircraft basic weight of 0.5 inch or takeoff weight of 0.3 inch. This weight and balance change is for this test installation only and does not represent a production design change.

APPENDIX "D"

DEMONSTRATION FLIGHT PLAN

1.0 INTRODUCTION

1.1 The Demonstration Flight Plan is designed to demonstrate that the performance in an operational environment of the navigation/weapons delivery system equipped with fiber optic interfaces is equal in all respects to the performance of a fleet configured system in a similar environment. To accomplish this task, missions will be flown that will be identical to those flown in the Fleet and ALOFT/COPPER configurations and the collected data compared.

2.0 SCOPE

2.1 The demonstration flight phase of the ALOFT Program will consist of at least ten (10) flights. These flights will be identical to those flown during the baseline flights phase of the ALOFT program at NWC. However, these flights are limited in both nature and scope and it is desirable to schedule a number of additional flights to permit comparison of ALOFT/FIBER OPTIC configuration operation to fleet aircraft expectations. Further, a series of environmental flights, which are designed to stress the fiber optic system to operational limits, will be accomplished if the budget permits.

3.0 METHOD OF ACCOMPLISHMENT

3.1 Demonstration flights will be conducted using the NWC instrumented ranges. Range data will be correlated with data from the aircraft flight recorder from which analyses of system moding, computation accuracy, and sensor control can be made. When applicable, data will be presented in correlated summaries that reflect system accuracy.

3.2 Demonstration flights will be conducted in five phases. Phase I will consist of four (4) navigation flights; Phase II will consist of three (3) conventional weapons delivery flights; Phase III will consist of three (3) minimum release interval (MRI) flights; Phase IV will consist of one (1) Gun/Rockets flight; and Phase V will consist of a minimum of two (2) Environmental Flights, and one (1) Mines/Flares Delivery Flight.

3.3 PHASE I - NAVIGATION FLIGHTS. The flights to be performed to evaluate navigation functions are listed in Figure D-1. Each navigation flight will also be flown over a predetermined route with good visual and radar update points. Flights will be approximately 2.5 hours in duration and wind checks will be made during each leg of the flight. Updates will be performed every 10 to 15 minutes. The flights are structured to test navigation system operation under various alignment and mode conditions.

FLIGHT No.	TYPE	NAV MODE	TYPE ALIGNMENT
1	North-East	I	Complete ground alignment
2	North-East	I/DIG	Complete ground alignment
3	North-East	DIG	Coarse leveling complete; airborne alignment
4	North-East	DIG	Coarse gyrocompassing only; airborne alignment
NOTE: All updates will be functionally checked on each flight, also wind and Doppler checks will be made.			

Figure D-1. Navigation Test Flights

3.3.1 As each navigation test flight is completed, an entry to that effect will be made on the Navigation Test Flight Data Sheet shown in Figure D-2. Discrepancies noted will be recorded on the appropriate record sheets.

3.3.2 The direction and amount of navigation error noted for each flight will be recorded on the form illustrated in Figure D-3. Present position error at the midpoint of the flight and upon landing will be recorded on this data sheet.

3.3.3 Present position error will be determined at regular intervals throughout each flight. Figure D-4 illustrates the Update Mode Accuracy Data Sheet. On this form, the difference in present position error that exists between a flyover update and the update method specified on the data sheet will be recorded. Differences (deltas) will be presented in seconds of present position error along and across the aircraft ground track and will be averaged values.

3.3.4 Wind checks will be performed and recorded during each navigation flight by performing a box pattern at constant altitude and noting the wind velocity and bearing at each cardinal heading. Wind computation data will be recorded on the data sheet illustrated in Figure D-5.

FLIGHT No.	NAV MODE	TYPE ALIGN	START DATE	COMPL DATE	AIRCRAFT CONFIG.			DISCREPANCIES NOTED / REMARKS	MAF/ALOFT LOG No.
					F	AC	FO		

Figure D-2. Navigation Test Flight Data Sheet

NAV MODE	ALIGNMENT	TOTAL FLT TIME		LANDING ERROR			MIDPOINT UPDATE ERROR		
		HR	MIN	DIR	MIN	SEC	DIR	MIN	SEC

Figure D-3. Navigation Accuracy Data Sheet

UPDATE MODE	RANGING	NAV MODE	Δ ON TRACK, (SEC)	Δ CROSS TRACK (SEC)	NO. OF SAMPLES
HUD	FLR	PRIME			
HUD	BARO	PRIME			
HUD	RAD ALT	PRIME			
RADAR	BARO	PRIME			
RADAR	RAD ALT	PRIME			

Figure D-4. Update Mode Accuracy Data Sheet

FLT NO.	IMS MODE	ALIGNMENT	WIND VELOCITY & DIRECTION			
			0°	90°	180°	270°

Figure D-5. Wind Velocity Data Sheet

3.4 PHASE II - CONVENTIONAL WEAPONS DELIVERY FLIGHTS. Weapons delivery flights will be flown to verify conventional weapons delivery computations and moding.

3.4.1 A description of the conventional weapons flights is presented in Figure D-6.

3.5 PHASE III - MRI EVALUATION FLIGHTS. MRI evaluation flights will be flown to test the accuracy of the MRI equation computations and moding. The flights will be structured to test each MRI class for accuracy of the MRI computations at different values of normal acceleration. The moding will be checked to verify that the proper MRI class is selected by the OFP according to the ASCU code, retard switch for pilot option weapons, number of stations selected, and the quantity thumbwheel setting, for conditions concerning automatic reversion to the Class II (safe MRI) feature.

Flight/ Pass No.	Wpn/ASCU Code	Rack/Sta	Qty/Int (ft)	Attack	Del. Mode	Nav. Mode	Ranging	Remarks/ Loading
5 & 6/ Pass 1	Mk 76/XHR	MER/2 & 7	01/010'	Normal	St Path 30-45° Dive	Inertial	FLR	
Pass 2	"	"	"	"	"	"	BARO	
Pass 3	"	"	"	"	Dive Toss	Inertial	FLR	
Pass 4	"	"	"	"	"	"	BARO	
Pass 5	"	"	"	"	St Path	DIG	FLR	
Pass 6	"	"	"	"	"	"	BARO	
Pass 7	"	"	"	"	Dive Toss	DIG	FLR	
Pass 8	"	"	"	"	"	"	BARO	
Pass 9	"	"	"	"	St Path	DIG	RAD ALT	
Pass 10	"	"	"	"	"	Inertial	"	
Pass 11	Mk 76/XHR		03/010'	Manual Ripple	Level	I	N.A.	Fully loaded MER's Stations 1, 8, 2 & 7
Pass 12	"		03/300'	"	St Path	IMS FAIL	"	

Figure D-6. Conventional Weapons Flights Matrix. (Sheet 1 of 2)

Flight/ Pass No.	Wpn/ASCU Code	Rack/Sta	Qty/Int (ft)	Attack	Del. Mode	Nav. Mode	Ranging	Remarks/ Loading
7/ Pass 1	Mk 76/XHR	MER/STA 2 & 7	01/010'	Radar	St Path 45° Dive	I	BARO	
Pass 2	"	"	"	"	"	"	RAD ALT	
Pass 3	"	"	"	"	"	DIG	BARO	
Pass 4	"	"	"	"	Level 200'-500' AGL	DIG	BARO	
Pass 5	"	"	"	"	"	I	BARO	
Pass 6	"	"	"	"	"	"	RAD ALT	
Pass 7	"	"	01/010'	Normal Offset	St Path 45° Dive	I	BARO	
Pass 8	"	"	01/010'	Radar	"	I	RAD ALT	
Pass 9	"	"	01/010'	Nav with Update	"	DIG	BARO	
Pass 10	"	"	01/200'	Radar Offset	"	DIG	RAD ALT	

Figure D-6. Conventional Weapons Flights Matrix. (Sheet 2 of 2)

3.5.1 The MRI flights will be evaluated by noting the interval and pulse width of the recorded fire release pulses from the computer and comparing this interval with the MRI equation for the value of normal acceleration recorded at release. The interval between fire release pulses should be as programmed with no discernible error.

3.5.2 A description of the MRI evaluation flights is presented in Figure D-7.

3.6 PHASE IV - GUN/ROCKETS FLIGHTS

3.6.1 One flight will be flown to demonstrate the operation of the weapons delivery system and the computer for rocket and internal gun firing. A description of the gun/rockets flight is presented in Figure D-8.

3.7 PHASE V - ENVIRONMENTAL FLIGHTS

3.7.1 This phase will consist of Mines/Flares delivery flights and pilot-induced stress flights, fast altitude changes, etc., while observing the HUD (prime mode) and will include releases of MK-84 conicals. Specific requirements will be determined by the project engineer as the program progresses.

4.0 DOCUMENTATION

4.1 Completion of each of the required demonstration test flights will be recorded on the form illustrated in Figures D-9. Discrepancies will be recorded on the appropriate record sheets.

Flight/ Pass No.	WPN/ASCU Code	Qty/ Int. (ft)	Rack/ Stations	Del. Mode	Attack Mode	g	MRI Class	Loading/Remarks
8/ Pass 1	Mk 82 LDGP/ XGO	03/010'	Parent 1, 8, 2	St Path	Normal	<1	III	One Mk 82 on each parent station/ MRI Class I
Pass 2	"	"	Parent 7, 3, 6	Dive Toss	"	>2	III	
9/ Pass 1	Mk 76 XHR	"	2 MER	Dive Toss	Normal	>2	I, II	6 Mk 76 on MER STA 2, 6 Mk 106 on MER STA 7.
Pass 2	"	"	"	St Path	"	<1	"	
Pass 3	Mk 106 XHP	"	7 MER	"	"	<1	"	
Pass 4	"	"	"	Level	Manual Ripple	1	"	
10/ Pass 1	Mk 83 Con/ XGS	"	Parent-1 MER-7	St Path	"	<1	II Safety Feature	1 Mk 83 con on Parent 1 and 8, 2 Mk 83 con on MER's 2 and 7.
Pass 2	"	"	Parent-8 MER-7	Dive Toss	"	>2	"	

Figure D-7. MRI Weapon Flights Matrix.

Flt/ Pass No.	Weapon	Launcher/ Station	Attack Mode	Del. Mode	Nav. Mode	Ranging Mode	Gun Sw	Remarks
11/ Pass 1	M-61	-	Normal	St Path 30°	I	FLR	Lo	Don't fire until IN-RNG Cue.
Pass 2	M-61	-	Nav	St Path 30°	I	FLR	Lo	"
Pass 3	M-61	-	Radar	St Path 30°	DIG	BARO	Lo	"
Pass 4 Pass 5	Rockets	One each LAU-3 with nineteen 2.75"rockets, loaded on TERs on Stations 2 & 7. LAU-3 on single release. FIRE IN PAIRS.	Normal	St Path 30°	DIG	FLR	-	Do not deselect Master Arm
Pass 6 Pass 7	Rockets		Nav	St Path 30°	I	FLR		
Pass 8 Pass 9	Rockets		Radar	St Path 30°	I	BARO		
Pass 10 Pass 11	Rockets		Normal	St Path 30°	Open Loop	FLR		
Pass 12 Pass 13	Rockets		Normal	St Path 30°	MS	FLR		
Pass 14	M-61		Normal	St Path 30°	MS	FLR	Hi	

Figure D-8. Gun/Rockets Mode Flights

FLIGHT No.	TYPE FLIGHT	AIRCRAFT CONFIG. F	AC	FO	START DATE	COMPL DATE	DISCREPANCIES NOTED/ REMARKS	MAF/ALOFT LOG. No.

Figure D-9. Flight Data Sheet

4.2 DATA REDUCTION

4.2.1 The following types of data will be available for evaluation after each flight:

4.2.1.1 SCAN PROGRAM: The Scan Program prints out the logical choices and the discrete input and output words from the Tactical Computer. This program enables the analyst to make judgements as to the various phases of the equipment that were in operation during the pass and to determine the portion of the pass that is to be examined. The state of the logical and discrete words are printed out at the beginning of each pass. When the state of one of the logical or discrete words changes, a record of the change and the time of occurrence are printed out. Figures D-10 through D-12 present the words and bits that are tested.

Logic Choice	Interpretation
LCBU	0, + Normal Nav - Back-up Nav
LCR1	0, + IMU data reasonable - IMU data not reasonable
LCRDOP	0, + Doppler data reasonable - Doppler data not reasonable
LCBP	0, + No interpretation - Alignment complete
LCDOP	+, -, > 1 Doppler on 0, 1 Doppler off
LCTD	- Target designated 0, + No interpretation
LCPCI	- Pilot driving AR with TWE 0 Pilot not driving AR + Pilot driving AR with BC

Figure D-10. A-7E Logic Choices.

Word	Bit	Interpretation
1	0-7	ASCU weapon type selected
	8-13	spares
	14	ASCU control bit
	15	ASCU failure
2	0-7	number weapon selected
	8-15	release interval X10 (feet)
3	0	Tacan parity valid
	1	Station #1 ready
	2	Station #2 ready
	3	Station #3 ready
	4	Station #6 ready
	5	Station #7 ready
	6	Station #8 ready
	7	Guns selected
	8	Release enable depressed
	9	multiple racks selected
	10-14	none
	15	target designated
4	0	High drag bomb selected
	1	normal mode
	2	offset mode
	3	Radar mode
	4	Nav bomb mode
	5	Terrain following mode
	6-14	none
	15	HUD reliable
5	0	IMS reliable
	1	aircraft airborne
	2	none
	3	ground align mode
	4	IMS in normal mode
	5	IMS in inertial mode
	6	IMS in platform grid mode
	7	IMS in mag slave
	8	IMS system not ready
	9	IMS auto cal mode
	10	NAV/WD panel self-test
	11	Signal converter over temp
	12	ADC failed
	13	Pairs selected
	14	none
	15	aircraft carrier based

Figure D-11. Discrete Inputs.

Word	Bit	Interpretation
1	0-7	Spares
	8	tone
	9	Fire ready
	10	Bomb release
	11	Spare
	12	Radar cursor enable
	13	Radar antenna slave command
	14	NAV/WD panel failure
	15	Spare
2	0	IMS auto calibrate
	1	Spare
	2	IMS X slew
	3	IMS X slew sense
	4	IMS azimuth slew
	5	IMS azimuth slew sense
	6	IMS Y slew
	7	IMS Y slew sense
	8	Latitude greater than 70 deg
	9	Non-align on IMS
	10	Computer failure
	11	Spare
	12	Horizontal situation indicator
	13	IMS under computer control
	14	IMS scale factor change
	15	Spare

Figure D-12. Discrete Outputs.

4.2.1.2 FLIGHT RECORDER LIST PROGRAM. The Flight Recorder List Program tabulates, in engineering units, the data utilized in the Tactical Computer. These data are listed in Figure D-13 and are printed out in the order they are requested with the exception of the discretes, which are separated and listed last. The timing is with respect to zero or release time. The data can be printed at various time intervals with different sampling rates during a pass.

4.2.1.3 CORRELATION PROGRAM. The Correlation Program compares the Flight Recorder data to flight data obtained from ASKANIA cameras or radar. This program compares the data utilized in the Tactical Computer to determine aircraft position with aircraft position measurements made on the NWC ranges. Aircraft position is determined from the aircraft velocity and the elevation, azimuth, and flight path angles. If atmospheric data is available, further comparisons requiring wind and pressure are made. The mean error, standard deviation, and the root mean square of the differences are computed. The output consists of smoothed range data and the delta values. The raw data is not tabulated because it is an output of the list program. A list of the tabulated, correlated data that is printed out is presented in Figure D-14.

Word	Symbol	Name	Units
1	I	Altitude Integrator Output	FRSQ
2	LAMPP	Present Position Latitude (High)	DEG
4	PHIPP	Present Position Longitude (High)	DEG
6*	KNT	Number Passes Since Power Up (High)	PASSES
8	ALFAIN	Angle of Attack (α)	DEG
9	ALFAWIG	Smoothed Angle of Attack (α smoothed)	DEG
10	THETAP	Platform Pitch Angle (θ)	DEG
11	PHIP	Platform Roll Angle (ϕ)	DEG
12*	PSIP	Platform Yaw Angle (χ)	DEG
13	DVE	Inertial Acceleration, East (High)	FT/SEC
14	DVN	Inertial Acceleration, North (High)	FT/SEC
15	DVV	Inertial Acceleration, Vertical (High)	FT/SEC
16	LCNIP	Navigation in Process Logical Choice	
17	LCBU	Back-Up Navigation Logical Choice	
18	LCRI	IMU Data Reasonable Logical Choice	
19*	VEE	Fast Loop Inertial Velocity East High	FT/SEC
20*	VNN	Fast Loop Inertial Velocity North High	FT/SEC
21*	VVV	Fast Loop Inertial Velocity Vert. High	FT/SEC
22	LAMAFM	FPM Command, Azimuth	DEG
23	LAMEFM	FPM Command, Elevation	DEG
24*	HP	Pressure Altitude (h press)	FEET
25	PSIM	Magnetic Heading Angles	DEG
26*	VE	Inertial Velocity, Navigation East High	FT/SEC
28*	VN	Inertial Velocity, Navigation North High	FT/SEC
30*	VV	Inertial Velocity, Navigation Vert. High	FT/SEC
32	LN	Gyro Torquing North High	PULSES
33	LE	Gyro Torquing East High	PULSES
34	LV	Gyro Torquing Azimuth High	PULSES
35*	ZRA	Radar Altimeter Altitude	FEET
36*	VD	Doppler Velocity	FT/SEC
37	SSIGD	Doppler Drift Angle	DEG
38	HD	Altitude Difference	FEET
39*	VA	Airspeed Navigation	FT/SEC
40	DI 1	Discrete Input Word=1	
41	DI 2	Discrete Input Word=2	
42	DI 3	Discrete Input Word=3	
43	DI 4	Discrete Input Word=4	
44	DI 5	Discrete Input Word=5	
45	DO 1	Discrete Output Word=1	
46	DO 2	Discrete Output Word=2	
47	LCRDOP	Logical Choice (DOPPLER REASONABLE)	
48	WEPTIME	Time to do Weapon Cycle	SEC
49	SK3	Gyro Gain	
50	LCBP	Logical Choice	

Figure D-13. Flight Recorder List (Sheet 1)

Word	Symbol	Name	Units
51	LCDOP	Doppler Status Word	
52	DLAMHI	Latitude Correction High	DEG
53	DPHIHI	Longitude Correction High	DEG
54	SDVN	Velocity Error North	FT/SEC
55	SDVE	Velocity Error East	FT/SEC
56	CA	Bullpup Command, Azimuth	SEC
58	DTWE	TWE Command	SEC
59*	RFLR	Forward Looking Radar Slant Range	FEET
60*	ZB	Ballistic Altitude	FEET
61*	REN	Range to Target, East	FEET
62*	RNN	Range to Target, North	FEET
63*	RVN	Range to Target, Vertical	FEET
64*	LAMARLH	LOS-To-Target, Azimuth	DEG
65*	LAMERLH	LOS-To-Target, Elevation	DEG
66*	VWEWIG	Smoothed Wind, East	FT/SEC
67*	VWNWIG	Smoothed Wind, North	FT/SEC
68*	VAEBAR	Weapon Release Airspeed, East	FT/SEC
69*	VANBAR	Weapon Release Airspeed, North	FT/SEC
70*	VAVBAR	Weapon Release Airspeed, Vertical	FT/SEC
71	MNBAR	Mach Number	
72*	RHO	Air Density	SLUGS/FT3
73*	MI	Miss Distance	FEET
74*	RIE	Impact Point East	FEET
75*	RIN	Impact Point North	FEET
76*	VO	Weapon Release Airspeed	FT/SEC
77	LAMEIH	Pointing Angle to Impact Point, Elevation	DEG
78	EBETA	Steering Error	DEG
79	LAMARH	Aiming Reticle Command, Azimuth	DEG
80	LAMERH	Aiming Reticle Command, Elevation	DEG
81	LAMAPHIO	Unrolled AR Command	DEG
82	LMARRFLR	FLR Command Azimuth	DEG
83	LMERRFLR	FLR Command Elevation	DEG
84	TG-1	Time-to-Go to Release	SEC
85	LMPEPU	Pullup Cue Command	DEG
86	NB	Number of Bombs	
87	CTIME	Corrected Time for 10 Bit Interrupt	SEC
88	SINTHO	Weapon Flight Path Angle	DEG
89	LMPECL	Lower Solution Cue Command Elevation	DEG
90	TF	Weapon Time of Fall	SEC
91	X1	Weapon Downrange Distance	FEET
92	W/CDA	Weapon Drag Parameter	
*93	R	Computer Range to Target	FEET
94	SIG	Inertial Drift Angle	DEG
95	KNT	KNT at TGI Load Low	COUNTS
96	LCTD	Target Designate Logical Choice	
97	LCPCI	Weapons Logical Choice	
98	TIMETW	Go-No Go Time	SEC
99	PRC-2	Time Loaded Into PRC-2	SEC

* These must be included in the tabulation of the list program if the correlation program is to be used.

Figure D-13. Flight Recorder List (Sheet 2)

Page 1

Column	Heading	Remarks
1	Time	With respect to launch
2	V EAST	Velocity, East
3	V NORTH	Velocity, North
4	V VERTICAL	Velocity, Vertical
5	V TOTAL	$\sqrt{VE^2 + VN^2 + VV^2}$
6	ΔVEE	Word 19 - VE
7	ΔVNN	Word 20 - VN
8	ΔVVV	Word 21 - VV
9	ΔV TOT	$\sqrt{VEE^2 + VNN^2 + VVV^2}$ - V total
10	ΔVE NAV	Word 26 - VE
11	ΔVN NAV	Word 28 - VN
12	ΔVV NAV	Word 30 - VV
13	ΔV DOP	Word 36 (doppler velocity) - $\sqrt{VE^2 + VN^2}$

Figure D-14. Correlated Data List (Sheet 1)

Page 2

Column	Heading	Remarks
1	Time	
2	R EAST	Range to Target, East
3	R NORTH	Range to Target, Vertical
5	ΔREN	Word 61 - RE
6	ΔRNN	Word 62 - RN
7	ΔRVN	Word 63 - ALT
8	ΔHP (Pressure Alt)	Word 24 - ALT
9	ΔZRA	Word 35 - ALT
10	ΔZBS	Word 60 - ALT
11	SLANT R (LOS DIST)	Slant range = $\sqrt{RE^2 + RN^2 + RV^2}$
12	ΔR RAD	Word 59 - S.R.
13	ΔR COMP	Word 93 - S.R.

Figure D-14. Correlated Data List (Sheet 2)

Page 3

Column	Heading	Remarks
1	Time	
2	AZ ANG	arc tan (RE/RN)
3	ΔA ANG	Words (64 + 12) - AZ
4	DIP ANG	arc tan $(RV/\sqrt{RE^2 + RN^2})$
5	ΔD ANG (θp - EL LOS to Tgt)	Words (10-65) - D
6	FLT P A	FPA = arc tan $(VV/\sqrt{VE^2 + VN^2})$
7	ΔF PA	arc tan $(VVV/\sqrt{VEE^2 + VNN^2})$ - FPA
(if there is not atmospheric data, the comparisons end here)		
8	WIND X	Wx
9	ΔVWE (smoothed wind East)	Word 66 - Wx
10	WIND Y	WY
11	ΔVWN (smoothed wind North)	Word 67 - WY
12	RHO	Air Density
13	ΔRHO	Word 72 - RHO

Figure D-14. Correlated Data List (Sheet 3)

Page 4

Column	Heading	Remarks
1	Time	
2	TAS	$\sqrt{XW^2 + YW^2 + Z^2}$
3	ΔVA NAV	Word 39 - TAS
4	ΔVO WR (wpn release speed)	Word 76 - TAS
5	XW	VE - WX
6	ΔVAE	Word 68 - XW
7	YW	VN - WY
8	ΔVAN (wpn release airspeed No.)	Word 69 - YW
9	Z DOT	V - vertical
10	ΔVAV	Word 70 - VV

Figure D-14. Correlated Data List (Sheet 4)

APPENDIX "E"

RELIABILITY AND MAINTAINABILITY EVALUATION PLAN

1.1 PURPOSE

1.1.1 This plan provides the instructions and requirements for conducting a reliability and maintainability (R&M) evaluation of the ALOFT system when installed in an A-7C test bed aircraft.

1.1.2 The R&M evaluation will be conducted concurrent with the Flight Test Program at NWC by personnel from the Naval Air Test Center (NATC), Patuxent River, Maryland.

2.1 SCOPE

2.1.1 The NATC R&M effort will include the following:

a. Monitoring of the progress, where appropriate, of the contractors development, testing, packaging, and integration of the ALOFT System.

b. Establishment and maintenance of a data collection system for analysis and reporting of R&M throughout the period of the evaluation.

c. Evaluation of components and system for features which enhance and/or degrade system R&M.

d. Evaluation of the adequacy of the proposed maintenance concept, Level of Repair (LOR), and other supportability parameters applicable to the installation.

e. Evaluation of fault detection and isolation provisions and capabilities including trade-offs for PGSE, Built-In Test (BIT), and troubleshooting.

f. Determination of skill levels and training requirements applicable to fleet maintenance.

g. Evaluation of accessibility for visual and manipulative tasks, interchangeability, safety, weight, environmental, and labeling of assemblies and components where possible.

h. Determination, if possible, of the peculiar support equipment or facilities required to maintain the ALOFT system.

3.1 METHOD OF ACCOMPLISHMENT

3.1.1 The R&M program will be accomplished by qualitative and quantitative evaluation of the aircraft modification installation; by monitoring the flight test program after installation of the ALOFT modification; and by collection and analysis of all maintenance and failure data pertaining to the ALOFT-peculiar and ALOFT-related components.

4.1 DOCUMENTATION

4.1.1 Monthly letter or message reports of significant findings and and unusual events will be submitted to NELC by NATC.

4.1.2 In addition, a final report will be submitted not later than sixty (60) days after completion of the flight test program.